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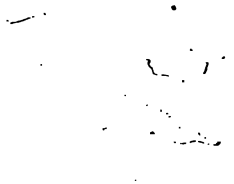
THE PRACTICAL DETAILS OF CATARACT EXTRACTION



THE PRACTICAL DETAILS

OF

CATARACT EXTRACTION

BY

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PREFACE

THIS account of cataract extraction and of matters directly bearing upon it differs from others in that it is largely made up of a mass of practical detail, ordinarily omitted; and it includes a certain amount of original observation throughout. I have attempted to record what I have learnt from the performance of between two and three thousand operations, and from teaching, both in the lecture theatre and in hospital, since 1895. Such an attempt must always be imperfect, mere verbal description falling short of demonstration, which again ranks in instructiveness far below actual performance and its responsibilities. Yet, since it is a working knowledge of the small and often apparently trivial facts here given that constitutes success, their accumulation in print must do something to bridge over the gap between the beginner and the finished operator. No detail is too small for recognition that is practical and not too obvious, and that helps in any degree towards good results. The description has gradually grown—at first without intention—from notes of difficulties and mistakes as they have been encountered, additions and modifications being adopted with regard especially to direct practical application. The exceptional success which has attended the execution of

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the rules and precautions laid down appears to warrant their collection and elaboration in this present form. At the same time the recognition of other means of attaining the same ends may serve to apportion the influences of Oriental surroundings and perhaps personal bias. Though my work has lain wholly in India, it should prove of use to students and practitioners elsewhere. Allowing that the clean constitutions of natives of India make them good subjects for operations generally, this advantage in eye surgery is probably more than counterbalanced by the bad average local (conjunctival) conditions.

C. J. Ophthalmic Hospital, Bombay,
December, 1902.

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ERRATA

Page 17. The *last* line of 'MIXED TYPES' should be the *first* line of 'THE SHRINKING TYPE.'

Page 104. The upper two of the four illustrations should have been printed on p. 31, and should have appeared as below:

THE PRACTICAL DETAILS OF CATARACT EXTRACTION

CHAPTER I

OPERABLE CATARACT

Definitions—Progressive Cataracts—Stages aud Varieties—Liquefying Cataracts — Shrinking Cataracts — Hypersclerosis — Secondary and Traumatic Cataracts—Duration—Operability —Volume of Cataractous Lenses.

THE term 'cataract' denotes opacity of the crystalline lens. Its nature and varieties will be entered into here only so far as appears necessary from their bearing on treatment. The term 'capsular cataract' never indicates loss of transparency of the true capsule of the lens, but is applied to abnormal proliferations of the lens-cells which normally line only the anterior capsule, but which in some cataractous lenses may extend around over the whole of the posterior capsule also. The new formations are within the true capsule, but are inseparable from it. 'After-cataract'—also known as 'secondary cataract,' thus unnecessarily introducing confusion with cataract secondary to other diseases of the eye—is the membranous opacity which frequently interferes with vision after removal of the lens. It may be capsular cataract in the above sense; the name is also less correctly applied to deposit on the front of the capsule—*i.e.*, strictly speaking, 'pupillary membrane.'

The cataract may be partial, affecting only portions of

lens substance, or general. Completeness, or a near approach to it, is considered necessary for the treatment by extraction of the lens, which is almost the only recognised measure* nowadays for lenses with hard nuclei, absorption being practicable in young persons with lenses still 'soft.'

Progressive Cataracts, those which become general or complete, are classified thus:

I. **Primary,** independent of other recognisable affection of the eye. This includes by far the largest group, the purely idiopathic cases, mostly *senile*, yet occurring at any age, even before birth. Senility in this connection is in India a very relative term, since the cases begin to be numerous after forty years of age.† There are also the cataracts developing in diabetes, nephritis, extreme anæmia (see p. 13), tetany, and in ergotism; and glass-blowers' cataract.

II. **Complicated,** or **secondary** to obvious disease of the eye, *e.g.*, disease of the vitreous in high myopia with choroidal changes, and in late stages of retinitis pigmentosa; or due to advanced glaucoma, or to the effects of irido-cyclitis — atrophy of ciliary body and posterior synechiæ; or a result of dislocation of the lens.

III. **Traumatic,** due to penetrating wound, or merely to rupture of the capsule.‡ With these may be grouped

* Depression and reclination of cataracts, still very frequently performed by *vaids* and *hakims* in India, may, in very rare instances, be the only treatment available.

† It is not true, however, of Bombay that 'the majority of cataract patients come to operation at forty years or thereabouts' (Hirschberg, speaking of the East Indies generally, quoted in Norris and Oliver's 'System,' iv. 324). With us there are, roughly speaking, twice as many patients over fifty as under fifty years of age. Probably in the intense heat and glare of the northern plains of India cataract comes earlier.

‡ A few traumatic cataracts have been recorded without rupture of capsule, but they have been partial, and in some cases even transient.

the lenses 'needled' preparatory to removal in high myopia, or for lamellar cataract, etc.

There is a good deal of misunderstanding with regard to the stages and varieties of progressive cataract development.

The **Stages** into which it is convenient to divide the development of cataract are: (1) Incipient, (2) unripe, (3) ripe or mature, and (4) over-ripe. Cataracts are much more often allowed to become over-ripe in India than in Europe. It may be roughly stated that in the *incipient* stage they often require a dilated pupil or dark-room examination for their certain detection—for their distinction, for instance, from simple senile sclerosis. *Unripe* cataracts are at once recognisable with the naked eye, but there is still some transparent or semi-transparent cortical matter remaining. In the *ripe* stage the whole lens looks opaque. *Over-ripeness* is shown by certain secondary changes, and by the formation of capsular opacities, recognisable by being whiter than any superficial opacity of lens-substance.

The **Varieties** of cataract formation are not so clearly separable, combinations and connecting links serving to fill in the gaps between the different typical degenerations. It has long been recognised that hypermature cataracts fall into one of two groups—either (1) the Morgagnian, with fluid milky cortex, in which floats the nucleus; or (2) the flattened disc, with scanty, cheesy-looking cortex. But, though the ultimate effects of the two degenerations, the liquefying and the purely shrinking, are at once separable, very little attempt has been made to trace the two typical processes, and their various combinations, back to their early beginnings. Again, these changes in old people tend to be mainly confined to the cortex, the hard nucleus being more

resistant. But this protective nuclear sclerosis may in abnormal excess itself produce a form of opacity, either combined with one of the above changes or alone, and extending to nearly the whole of the lens-substance. Finally, there are the capsular opacities which come with over-ripeness, and which indicate a stage rather than a variety of cataract.

In Indian practice there is little opportunity to trace the changes as they occur in individual cases; but a good deal may be learnt from a careful examination and record of the appearances and physical features of many hundreds of cataractous lenses, before and after their extraction, aided by microscopical examination of the more typical forms.

I. **Liquefying Cataracts.**—The typical *Morgagnian* cataract, with floating nucleus, is occasionally not recognised as such—unless the pupil be dilated—until the patient is placed on the table for operation. With the patient erect the nucleus may lie close against the anterior capsule, producing exactly the appearance of some shrinking lenses. Usually, however, at least the upper part of the nucleus is covered with a thin layer of 'milk,' and bending the head backwards gives a quite characteristic uniform skim-milk appearance. Extremely rarely there are glittering cholesterine crystals floating in the fluid. The nucleus on extraction is found to be small, and perhaps a little irregular from partial absorption, either transparent or semi-opaque; occasionally larger and dark, from hypersclerosis. The capsule is either transparent, or there is faint diffuse opacity only, or this with numerous small brilliantly white dots, extending at times more or less over the posterior portion as well as the anterior. These opaque capsules are inelastic, so that the edges of any opening made in them tend to come together again. The anterior chamber is at times shallowed.

The few measurements of such lenses given in the table at the end of this chapter show that this shallowing may represent, in part at least, actual increase in volume of the lens above normal. Other possible additional explanations are displacement forwards of the lens, and alteration of its shape, corresponding with the change in its consistence. If left, the fluid tends to gradually diminish in quantity, and may ultimately entirely disappear, leaving only the nucleus in a shrunken capsule. Here again, with undilated pupil, a mistake may readily be made as to the nature of the cataract, the nucleus acquiring a greenish or grayish tint from the conditions under which it is seen. Both it and the iris are, however, frequently more or less tremulous; and if the pupil be dilated, the upper edge of the nucleus may perhaps be seen, and the patient may then acquire fair vision.

> Apart from obviously displaced lenses, the majority of tremulous cataractous lenses seen in Bombay are of this class. The tremor is sometimes more noticeable with the patient lying on his back than in the erect attitude. It indicates simply a relaxed zonule and capsule, owing to the nearly complete emptying of the latter.
>
> Twice I have found that the nucleus had disappeared, and not the fluid; the latter had acquired a slightly creamy tint.

Working backwards from the typical Morgagnian cataract, there are lenses with only the superficial cortex quite fluid. The deeper soft lens-matter may have only sufficient consistence to limit the movement of the nucleus, or, in slightly less advanced cases, may come away partly in small flakes, the rest remaining adherent to the nucleus.

Then there are *ripe* cataracts, with the whole of the cortex opaque, soft, whitish, without definite structural markings within the undilated pupil, but on extraction breaking up in its equatorial portions into more or less

triangular fragments of lens-sectors, which float away as large flakes.* The anterior chamber is, as a rule, of nearly normal depth.

The *unripe* stage of the liquefying form of cataract is presumably its most swollen stage, since the anterior chamber is regularly and distinctly shallowed.† The bluish-white opacity is far from uniform; the brightly glistening apices of opaque sectors are seen within the normal pupil, separated by transparent lens-substance. In some less typical, less swollen lenses the division into sectors may be only towards the equator, the central semi-opacity being diffused. In either case the superficial layers are affected; in the former there is no shadow shown by the iris, in the latter only a faint one. The nucleus is very often pale and transparent.

II. **Shrinking Cataracts.**—The *over-ripe* lens is remarkable for its flattened discoid shape, and often for its small size; also for the amount of capsular thickening and opacity that develops, often with a large anterior central untearable patch, possibly containing lime deposits. What remains of the cortex consists chiefly in a broad equatorial ring, cream-coloured and fairly coherent, and separating readily from the nucleus. The latter varies in size and colour, as in Morgagnian cataracts; but it is commonly rather larger and less clear. Its colour is seen clinically through the scanty remains of anterior cortex. Very rarely the nucleus may have disappeared,‡ only scanty cheesy cortex remaining.

* It is doubtful if all of these lenses would eventually become Morgagnian. In some, especially young eyes, absorption might keep pace with the liquefaction, resulting in one of the mixed forms of degeneration. In a few of them there is already some slight capsular opacity.

† For glaucoma occasionally induced by this shallowing see Chapter V.

‡ Several times I have met with no nucleus, or only a trace of it, in patients whose estimated age was over fifty years.

In the *ripe* stage these lenses vary considerably in size and appearance. The diminution in size, especially in thickness, varies inversely with the degree of nuclear sclerosis, and therefore to a large extent with the age of the patient. A broad thin disc may result; but more frequently the contraction is lateral as well as antero-posterior. The nucleus ranges from opaque white or cream-coloured, in a few rather young lenses with defective sclerosis, through the average smoky brown, to the larger dark hypersclerotic nucleus. The lenses with whitish nucleus may appear perfectly ripe clinically, while on extraction the equatorial rim of cortex may be found quite or nearly transparent; this thin transparent or translucent rim is, however, firm, and separates whole from the capsule. In other lenses the distinction between nucleus and cortex is not very evident; the loss of transparency seems uniform throughout, but very incomplete. The degree of opacity is much less marked in the extracted lens than would be expected from the clinical appearance. There may be fine superficial radial slits or cracks on the anterior surface. In other cases the nucleus is covered by a separable thin layer of opaque cortex, either somewhat firm and consistent, or soft and moist, suggesting some admixture of the liquefying process;* but there is, as a rule, very little cortical matter behind the nucleus.

The *unripe* shrinking cataracts seen through the pupil have a diffused greenish appearance, perhaps tinged with olive from nuclear sclerosis, at other times grayish. A few of the grayish opacities are quite deep; there is a quantity of perfectly clear cortex through which a very distinct shadow is thrown by the iris, seen by looking

* Very rarely there are more opaque sectors, regularly arranged, as in the unripe swollen cataracts.

from the side at the eye placed facing the light. Th deep central uniform cloudiness may remain with b little change for years. In other eyes the semi-opaci comes well up to the iris, but it transmits a shadow fro the iris through the superficial layers. Such lenses m be fit for extraction, if small, with a rather deep anteri chamber, while the patient still counts fingers at 1 2 feet. The transparent appearance of such a lens aft removal is remarkable; there may be a small centr haze or cloud of opacity noticeable. The superfici layers, though so clear, are fairly firm and coherent, a shell out easily entire. Other larger lenses, more grayis supply a number of steps in the transition to the swoll cataract with liquefying tendency. It is impossible decide in many cases at this stage what the ultima tendency may be.

III. **Hypersclerosis** has been already referred incidentally. A varying degree of it is common, cor bined with superficial gray opacity. In rarer cases t hardening, darkening, and opacity may extend to all b the most superficial layers of the lens, which may eith remain transparent or undergo ordinary gray degener tion. The colour attained is finally pure black aft passing through a rich reddish-brown tint, which, ho ever, appears muddy only, as seen through the pu clinically. In pure hypersclerosis, since there may always a trace of normal cortex at the surface, t cataract may never become fully ripe,* and capsul

* Not long ago I extracted two perfectly black cataracts from patient. In each eye a considerable quantity of transparent corti matter was left, which became opaque, and was absorbed in t usual way. The only case of pure hypersclerosis in which remember seeing capsular opacity was remarkable in that t cataract was still brown, and there was colourless cortex at t equator and posteriorly, yet the hardening, dryness, and discolo tion had advanced quite to the anterior surface of the lens.

opacity is slight or absent. These lenses are always large; but their exact relation to the normal size has yet to be determined.

The Incipient Stage of cataract can as a rule be only observed clinically, without the opportunity of comparing the clinical appearances with the physical characters of the naked lens. A conclusion drawn from many dark-room examinations in Bombay is that, whatever the ultimate tendencies of cataractous degeneration may be—apart from hypersclerosis—the early beginnings are much the same. Most commonly the ophthalmoscope revealed a faint gray central haze, partly obscuring a dark defined posterior polar patch, which was often connected by irregular streaks with a posterior equatorial arc of opacity. The latter was frequently most developed downwards and inwards; and there was often a slighter degree of similar opacity in front of the equator also. Occasionally the central gray cloud was the only form of opacity. On the other hand, it was sometimes altogether absent, and perhaps the posterior polar patch also, the opacity then appearing as 'spokes' and wedges, coming in from the equator on both surfaces of the lens. This appeared to be an unusually early declaration of the liquefying tendency, shown also perhaps in a shifting sheen or reflexion of light from the surface of the lens on focal illumination.

Hypersclerosis is not particularly recognizable at an early stage with the opthalmoscope; only a general haziness is to be seen.

In Europe and America posterior polar opacity appears to have been much less frequently noticed in ordinary incipient cataracts, (see Norris and Oliver's 'System,' iv. 289). It is considered to belong more especially to secondary cataracts, with choroidal and vitreous disease (see Noyes, 'Diseases of the Eye,' p. 482). In Bombay there is a form of secondary cataract which is very common, viz., that found in advanced glaucoma; in this the posterior polar patch is not at all usual. Hence the inference that its special frequency in primary cataract here may represent the influence of the stronger light (and heat?) rays of the tropics.

Secondary and Traumatic Cataracts.

In the incipient cataract of advanced chronic glaucoma the pure central haze is very often the only form of opacity; this is quite distinct from simple sclerosis, and from the greenish appearance of the lens produced by dilatation of the pupil, and from general haze of the media of the eye. Cataract secondary to choroidal and vitreous changes is apt to remain long limited to the posterior surface. Traumatic cataract, uncomplicated with severe irido-cyclitis, affords the purest type of the swelling, liquefying degeneration. It is most important as a type, showing that cataract formation, to all appearance the same as in primary liquefying cataract, results from the simple free admission of aqueous into the lens. The result differs from that of primary liquefying cataract, in that free exit is provided for broken-down cortex, permitting of its rapid absorption; but the soft, plentiful, incoherent cortex is the same in both. It stands in direct contrast with some of the shrinking cataracts, where the opacity may be at first mainly deep; where the consistence and naked-eye appearance of fully ripe cortex may show no trace of abnormal moisture, but rather, perhaps, a lack of moisture; and where the double staining of microscopical sections may show the superficial equatorial layers to be the driest part of the lens.

This is not the place to enter into the *microscopical anatomy* of cataractous lenses. It may be merely suggested that small fluid-containing clefts found between shrinking lens-fibres, which may themselves be denser than normal, do not necessarily indicate any increase of fluid in the lens. On the other hand, the much swollen, rounded superficial fibres, which apparently produce the glistening appearance of the sectors in

the unripe liquefying cataract, themselves doubtless contain much more fluid than normal.

From all the above, ordinary progressive cataract formation appears to include two distinct processes, apart from hypersclerosis. Observation seems to show that the liquefying process may be seen quite early, or may be added to a degeneration already far advanced. A very late combination may rarely be seen in an over-ripe cataract, partly fluid, but containing also a coherent equatorial ring of soapy-looking cortex. An earlier combination may be seen in well-marked, whitish, nuclear opacity in fairly young subjects, together with ripe, soft, flaky cortex. And in the unripe stages the combinations are probably frequent, but not so clearly recognisable.

That the classification of the various changes is not pathologically of great importance is shown not only by their frequent blending, but by their obviously quite local determination, inasmuch as the two pure types of cortical degeneration are on rare occasions seen in the same patient, the one in one eye, the other in its fellow. Practically, however, for operative purposes it is an advantage to know beforehand what to expect.

Duration of the Changes.—The most rapid formations are the swollen, liquefying ones, as, indeed, one expects from a slight acquaintance with traumatic cataract. A month may produce a marked change in such lenses. To go to the opposite end of the scale, we have the pure central haze and hypersclerosis both extremely slow, perhaps changing very little in the course of several years. To formulate a rough-and-ready rule, one may say the deeper the opacity the slower it will be, the more superficial the change the faster it will progress.

OPERABILITY.

The question that immediately concerns us is whether a progressive cataract is *fit for extraction* or not. The practice in the Cowasjee Jehangir Hospital is to insist on three local conditions only with moderate general health.

1. *The cataract must be ripe enough.* Unless fairly mature, the soft sticky cortex will not separate from the capsule; some must be left behind. But complete ripeness is not required in either of the types of cataract formation. Immaturity entails an iridectomy as part of the operation, a full-sized incision, and very slow expression of the lens; the very shallow chamber of some unripe swollen lenses constitutes a difficulty, but not a serious one.

2. *The pupil should react well to light.* This is accepted as a practical guarantee that the fundus is sufficiently sound to justify operation. It does not, of course, guarantee the possibility of the attainment of very good vision. The test has proved sufficiently exact and reliable to serve in the hurry of hospital work.

The only case I can remember in which the test failed to reveal disease of the eye sufficient to contra-indicate operation was in an eye with rather high myopia. Afterwards much vitreous opacity was found, with probably a small retinal detachment. Though it is possible that these came on after operation (there was hæmorrhage into the anterior chamber afterwards), it seemed more probable that they had existed previously. The patient's vision after operation only reached to fingers at 1 foot, and even this sight was afterwards lost from hæmorrhagic glaucoma.

Central and other choroidal atrophy may not affect the reaction of the pupil to light; but in such affections the result, though possibly very poor, is yet sufficient to warrant operation. In high myopia the projection of light would always be examined for the detection of possible retinal detachment.

When the movement of the pupil is impaired, the tension of the eye and the projection of light in the dark-room are tested. In old people the pupil may be sluggish without indicating disease of the eye; when due to glaucoma, optic atrophy, etc., there is generally some enlargement of the pupil also. The latter cases must each be judged on their merits, according to the field of projection and other available data, the patient being warned not to expect too much, but to be satisfied with perhaps a poor result rather than none at all.

3. *There must be no inflammation about the eye.* Conjunctivitis must be treated until there is no discharge; or, if this be not quite feasible, special precautions must be taken. Dacryo-cystitis must be completely cured, either by probing the duct or, if necessary, by obliterating the sac. Stricture of the nasal duct, unaccompanied by mucoid secretion in the lachrymal sac, is probably of little or no consequence. There must be no trace of scleritis, keratitis, etc., nor any scabby skin eruption close to the eye.

As regards the *general health*, very little is exacted. The urine is never tested without special indications. Diabetes is practically ignored if the patient is fairly fit; the same with chronic nephritis without œdema. But œdema with albuminuria necessitates rejection. In Bombay we meet with extremely anæmic patients, with both eyes completely cataractous. They are sufficiently numerous to constitute a special group. The origin of the anæmia has not been determined; and the postponement of operation, for out-patient treatment of the general condition, has meant that only few of them have been operated upon. Incurable chronic bronchitis is not a contra-indication, though the cough presumably

predisposes to prolapse of the iris,* and more definitely, in my experience, to slight iritis; temporary alleviation is of course advisable. Extreme old age is no bar to operation, though it imposes watchfulness in the after-treatment.

No mention is made above of corneal opacity; if the cornea be transparent enough to allow the state of the lens and pupil to be made out, the patient should see sufficiently well afterwards. Pterygium, if large, may need to be removed; but if small it may be left.

Good sight in one eye influences the question of operation on the other eye only in so far that it permits of waiting for complete ripeness of the cataract without serious inconvenience. The cataract must not be allowed to become hypermature, because it is then in a less favourable state for extraction. After the extraction, though both eyes do not work together, there is the satisfaction of being provided for during the expected slow onset and progress of opacity in the other eye.

It is not justifiable to operate on both eyes of a patient at the same time for the extraction of cataract. The possible loss of both eyes is too terrible to be risked; also, operation on one eye may serve to suggest special precautions in dealing with the other eye; and, finally, one eye alone may after operation stand in need of atropin instillation to the full extent that the patient can bear constitutionally.

Very, very rarely a cataract may be fit for extraction, and yet the operation may be impossible. Not long ago I had to depress the lens in each eye of a patient with extremely small corneas—a congenital defect, associated with coloboma of the iris.

When one eye has been lost from profuse intra-ocular hæmorrhage complicating cataract extraction, it is a question whether reclination should be preferred on the second eye, or whether extraction should be attempted after a preliminary iridectomy. Unless the previous hæmorrhage had been uncontrollable, there would appear to be a fair chance of successful extraction thus,

* With a chronic cough iridectomy is imperative. I have operated thus on patients with very persistent cough without meeting with prolapse.

after lowering the general blood-pressure by suitable drugs, and with the adoption throughout of the sitting posture. Calcium chloride internally might limit the amount of any bleeding, though it could scarcely be expected to prevent it altogether.

A few words must be added regarding the *age of the patient* at which extraction becomes admissible. Absorption by needlings should be aimed at in infancy and young childhood, extraction being restricted as much as possible to patients who may be expected to exhibit some self-control after the operation. And up to the age when a hard nucleus may be forming (roughly thirty years), 'linear' extraction through a small wound replaces the ordinary operation.

VOLUME OF CATARACTOUS LENSES.

TABLE OF MEASUREMENTS TAKEN WITH PRIESTLEY SMITH'S LENS-MEASURER.

Age of Patients.	Variety of Cataract.	Volume of Lens (c.mm.).	Completeness or otherwise.
	LIQUEFYING CATARACTS:		
32	Ripe flaky lens; anterior chamber shallow	267	In its capsule
35–40	Morgagnian; anterior chamber rather deep. The upper margin of the (somewhat shrunken) lens was seen when the iridectomy was made	181	,,
42	Morgagnian, with most of the 'milk' absorbed; unusually large, pale, transparent nucleus	153	,,
45–50	Morgagnian	211	,,
52	,, opaque capsule	257	,,
50–55	,, ,, anterior chamber rather shallow; lens slightly tremulous ...	216	,,
50–55	,, anterior chamber not particularly shallow ..	235	,,
60–65	,, anterior chamber shallow; dark nucleus	296	,,
	MIXED TYPES:		
47	Whitish nucleus, but lens rather thick, and anterior chamber rather shallow	162	?
60–65	Nearly ripe; lens rather thick	169	Apparently complete

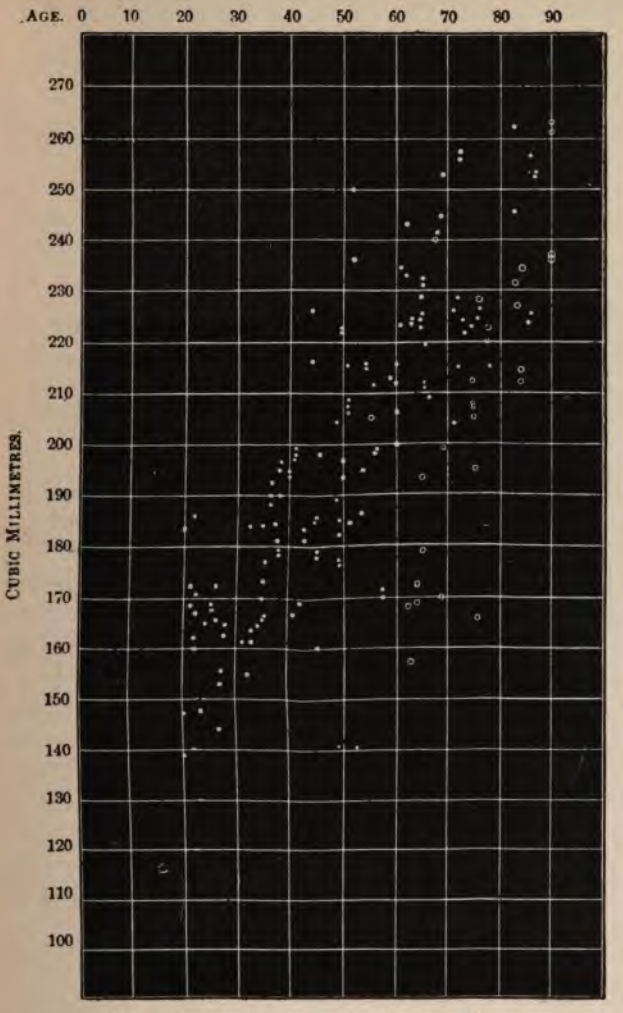
VOLUME OF CATARACTOUS LENSES—*continued.*

Age of Patients.	Variety of Cataract.	Volume of Lens (c.mm.).	Completeness or otherwise.
	MIXED TYPES—*continued :*		
62	Rather unripe, cortex soft, but not 'Flaky'	196	?
64	Ripe ; cortex rather soft	247	In its capsule
70	Cortex rather soft ; anterior chamber rather shallow	216	Not quite complete
74	Ripe ; rather discoid, but with hypersclerotic nucleus ...	169	,,
75	Nearly ripe ; rather soft cortex	191	Almost complete
103	Nearly ripe, cortex soft, but not 'flaky'	282	In its capsule
35	Small disc ; white nucleus, transparent equator	103	Almost complete
	THE SHRINKING TYPE :		
41	Ripe disc	113	,,
47	Rather transparent ; faint nuclear haze and slight posterior opacities	154	,,
45–50	Rather unripe ; whitish nucleus	152	Apparently complete
45–50	Whitish nucleus, transparent equator	144	?
51	Slightly over-ripe disc	186	In its capsule
50–55	Ripe ; uniformly semi-transparent ... ... pe	140	Apparently complete
,,	Small semi-transparent disc ; clinically appeared not quite ri...	105	,,
,,	Small semi-transparent ; nearly ripe	152	Not quite complete
,,	Fairly large ripe uniform disc ; nucleus rather dark	174	Apparently complete
50–55	Firm shrunken lens, only slightly opaque	154	,,
50–55	Ripe disc, semi-transparent equator	159	Nearly complete

VOLUME OF CATARACTOUS LENSES—*continued.*

Age of Patients.	Variety of Cataract.	Volume of Lens (c.mm.).	Completeness or otherwise.
	THE SHRINKING TYPES—*continued:*		
55–60	Ripe; rather thick; whitish, with slightly translucent equator	159	Not quite complete
,,	Unripe; very transparent; slight posterior opacities	171	Incomplete
57	Ripe disc	120	Not quite complete
58	Unripe; faint perinuclear haze	144	,,
60–65	Ripe disc	137	Apparently complete
68	Rather large, slightly overripe disc	170	Not quite complete
	PURE HYPERSCLEROSIS:		
62	Equator and posterior cortex colourless, otherwise dark brown	201	Incomplete
64	Fairly advanced, but not black	216	In its capsule

REMARKS.—A rough comparison with the size of the normal lens at the same age can in each instance be made by a glance at Priestley Smith's table, here reproduced. Probably some allowance should be made for racial difference, however. One must expect the average normal lens in India to be a little smaller than in Europe, corresponding with the poorer general physique of the people. The figures for the lenses measured in their capsules may be taken as fairly exact. It will be seen at once that in many of the liquefying cataracts the volume is well above that of the normal lens, whereas the shrinking cataracts show a considerable reduction in size. Reasonable objection might be taken to the figures of the shrinking cataracts. Since they were all measured minus their capsules, it is impossible to guarantee that a distinctly appreciable quantity of cortex may not have been missing in every case. These lenses were, however, selected out of many on account of their apparent completeness, or approach to completeness. I have no doubt that very small additions to the figures given would be required to represent the volume of the lenses in their capsules. These figures, however, are comparatively unimportant; they merely show approximately a reduction in size which is perfectly obvious to the unaided eye. Lenses were at times extracted distinctly smaller than any here given.



VOLUME OF LENS. (PRIESTLEY SMITH.)

One hundred and fifty-six lenses from the eyes of ninety-one persons. Weight of lens increases about four- and five-tenths milligrammes in each decade. Dots show clear lenses; circles show cataractous lenses.

CHAPTER II

DESCRIPTION OF THE OPERATION

General Considerations—The Preparation of the Patient—Preliminaries—Initial Steps—The 'Combined' Operation—The Iridectomy—The Capsulotomy—The Delivery of the Lens—Toilet of the Eye—Dressing and After-Treatment.

GENERAL CONSIDERATIONS.

THE path to success in this, the capital operation of eye surgery, is so beset with pitfalls and hedged in with difficulties and dangers, that even the experienced surgeon can scarcely hope to maintain throughout quite 100 per cent. of good results in dealing with uncomplicated cataracts only. Supposing that his precautions are worked out with mathematical exactitude and accuracy, he is always to an appreciable degree dependent on the good behaviour of the patient. And there are many eyes to be placed apart in reckoning results, owing to limitations imposed by associated opacities or disease. A brief glance over the chief sources of failure may serve to give some idea of the relative importance of rules and practices followed hereafter.

BAD RESULTS may be due to—

I. **Defective Operation,** particularized in—

(*a*) *Incorrect Method;* especially (1) inefficient measures for securing antisepsis or asepsis, or (2) inherent defects in the operative technique adopted.

(*b*) *Want of Skill* on the part of the surgeon. Dexterity in operating is made up of three elements, rising in order of importance thus: (1) A steady hand; (2) a light hand, combining a fine muscular sense with a delicate sense of touch; and (3), the most important, experience.

> Nos. 1 and 2 can be considerably developed apart from actual operative work. Numerous exercises for one's fingers may be devised to fit in with circumstances. A very useful practice is to carry about a fixation forceps with strong spring, and to train especially the left hand to manipulate the blades without tremor in various positions. Though No. 1 conduces particularly to *pretty* operations, No. 2 is more helpful in getting over difficulties and preventing accidents. Very nimble fingers are not required. No. 3 means a prompt recognition of the particular features of each case, and of difficulties and dangers as they arise. Practical experience can only to a limited extent be replaced by reading and by seeing others operate, and by operating upon dead eyes.

(*c*) *Want of Control* on the part of the patient. This may render the best efforts of the skilled hand unavailing; but the discerning operator may often judge beforehand when trouble from this cause is likely to be encountered, and lessen the dangers by training the patient.

II. **Eyes more or less unfit for operation.** The surgeon may have failed to realize the conditions, or he may have accepted risks under the pressure of circumstances, or he may have rightly decided to expect only a poor result, where no better was obtainable.

THE PREPARATION OF THE PATIENT.

In addition to ordinary cleanliness, and perhaps the administration of a mild laxative, the conjunctiva may require attention, and the patient's self-control may need developing.

When the *conjunctiva* looks normal, a simple light bandage is applied at night, and kept on for the surgeon's inspection next morning, to insure that any abnormal secretion of mucus may be visible. This test-bandage is quite necessary in our hospital practice, but with more intelligent private patients, who may be relied on to leave their eyelids untouched for morning inspection, it is better dispensed with, since it induces a slight temporary injection in some eyes. When the conjunctiva is already congested, and perhaps otherwise abnormal, but with only a trace of mucoid discharge, the patient is admitted, but the eye is at once washed out with 1 in 5,000 perchloride solution, and no bandage is applied at night. Other conjunctivæ, more definitely inflamed, are treated before the patient is admitted. In any case, operation is deferred if possible until the conjunctival sac and eyelids are found practically free from exudation; but occasionally, with chronic roughness and thickening of the lids, we have to operate when there is still a little morning discharge.* These cases are noted for freer perchloride irrigation at the time of operation.

To test the *patient's self-control* he is required to look steadily down while his eyelids are pulled about, and is made to follow his own hand well with his eyes in all directions. If he cannot maintain fixation thus for long, he is made to practise steadily.

We may have either nervousness or stupidity to contend with; fortunately, they are not very often combined. In nervous, frightened people one has to be aware of sudden upward movements of the eye, and of spasmodic closure of the lids. Some very nervous patients turn out extremely docile after a day or two's schooling. An extraordinary stupidity is met with here among cultivators who have been blind in both eyes for some time; they have often so lost the habit of fixation that at first they absolutely cannot look downwards or follow the movements of their hands, without moving their heads also. Most of them grasp the idea sufficiently after a few days, and are then usually steady enough. But one or two almost hopeless patients left the hospital, tired of being worried; and on a few others operation was performed under

* Rarely, under the pressure of circircumstances, I have operated when there was a very fair amount of discharge on the lid-margins in the mornings; exceptionally free treatment with perchloride, just before operation, has sufficed to prevent harm.

chloroform. It might perhaps have been done by downward section without chloroform. These poor people are often emaciated, with sunken eyeballs, and on them the ordinary incision cannot be made unless the eye be well turned down.

PRELIMINARIES.

The point and edge of the knife are tested on the leather drum. The instruments are cleaned and sterilized, while an assistant washes out the conjunctival sac with perchloride lotion, 1 in 3,000, and follows this by the instillation of freshly prepared cocaine solution, 4 per cent.

The cocaine drops are made with normal saline solution, recently boiled in the irrigator flask. They are dropped into the eye four times at intervals of 2½ minutes, thus extending the action up to ten minutes exactly. The eyelids are kept closed during this period, because of the well-known drying influence of the cocaine on exposed corneal epithelium. We have never used either eucaine or holocaine, being well satisfied with the better-known anæsthetic. And neither eserine nor atropine drops are instilled. Eserine is used by some operators before extraction with iridectomy, to prevent prolapse of iris afterwards, but it is unnecessary, and tends to increase the bruising of the iris during expulsion of the lens. Atropine drops are used by a few surgeons before extraction without iridectomy, to facilitate the passage of the lens through the pupil; but most competent judges consider the atropine somewhat liable to induce prolapse of iris.

The following *instruments* are required: A lid-speculum (the most generally used pattern is shown on the page of illustrations at the end of this chapter). Slightly curved scissors for cutting eyelashes. Fixation forceps, with three teeth on one blade, two on the other. A v. Graefe's knife of only medium breadth.* Toothed iris forceps bent to a right angle, and with rounded points—*i.e.*, free from sharp angles when closed. For iris scissors, either de Wecker's spring scissors or the old simple

* The broad blade supplied by some instrument-makers is much less manageable. The slightest alteration in its plane in cutting upwards lets all the aqueous escape, and brings forward the iris

pattern, according to personal choice. Scissors of the ordinary pattern should be 'elbowed' for use on the right eye, straight for the left eye. A v. Graefe's bent cystotome; the bend is not made the same for the two eyes, but either instrument may be used for each eye indifferently. A curette. And a tortoise-shell spoon. In addition, a Bowman's cataract spoon or Taylor's wire vectis should be ready at hand, in case it is needed.*

They are washed with soap and carbolic lotion, 1 in 40, and dried with bits of new lint, not previously exposed. The blades of knife and scissors are attended to by the surgeon himself. The points of the fixation- and iris-forceps and of the cystotome, as well as the curette and vectis and the silver nozzle of the irrigator, are all sterilized in the flame of a spirit-lamp. The irrigator-nozzle is heated till of a dull red, as a means of keeping its interior clear as well as sterile. It and the fixation-forceps and curette are cooled by being plunged into the carbolic lotion. After being sterilized, the instruments are laid out dry on a metal frame.

This mode of cleaning and sterilizing instruments suits our work, where the same set of instruments is used over and over again, as it admits of rapid repetition, so far as is necessary, before each operation. (The point only of the irrigator-nozzle is heated afresh for subsequent use, without removing the nozzle from the rubber tube.) A minor drawback to this practice is the slow destruction of the points of the steel instruments by the flame; occasionally a trace of black oxidized metal has to be scraped off them with an old cystotome. But the method appears more reliable than the practice of steam-sterilizing before the first operation of the morning, afterwards keeping the instruments in some sterile or antiseptic fluid, in which they are also washed before each subsequent operation.† The polished

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to be cut; the slight change in the plane of the knife may be involuntary, and only made known by its results, or it may be unavoidable with a shallow anterior chamber. This trouble with the iris is just what one would expect to avoid with a broad knife.

* A Tyrrell's iris-hook, also a Desmarres' lid-retractor, may very rarely be wanted—too rarely to be included with the regular list.

† Immersion in boiling water, repeated before each operation, is scarcely sure enough for the disinfection of the points of forceps and cystotome, unless rather prolonged; and we are always rather pressed for time.

blades of knife and iris-scissors are rendered sterile by simple washing; and the same probably applies to the tortoise-shell spoon and to the blades of the speculum, but they are of less importance in this respect than the actual cutting instruments.

During the operation, instruments that have to enter the wound are washed with lint in the bowl of perchloride standing near, and afterwards rinsed with a few drops of the salt solution from the irrigator, whenever soiled with blood or iris-pigment, or after by chance touching the lid-margin or eyelashes.

Some years ago Trousseau, of Paris, published some astonishingly good results from cataract extraction by the use of one instrument only—the knife. But, since sterilization is a simple and certain matter, handicapping one's self by discarding the most suitable instruments entails a purposeless strain on one's powers, a feat which no one desires to emulate.

The *irrigator* is a flask fitted with glass tubing, as in the ordinary laboratory wash-bottle, with an extension of rubber tubing, and a readily removable silver nozzle for insertion into the anterior chamber. Normal saline solution is boiled in the flask shortly before it is needed. The tubing is sufficiently sterilized by lying in strong perchloride lotion, and by having the same passed slowly through it, and retained within it.

As regards *antisepsis*, the action of the sublimate solution on the conjunctiva is discussed later (pp. 48 and 49). In average cases it should produce a moderate secretion of mucus, rich in epithelium, easily removable after the ten-minutes cocaine interval. Our arrangements for antiseptic irrigation are primitive. The fluid is squeezed out of moistened pads of lint, and thus dropped into the eye, the lids being held everted and moved about a little to allow of penetration to the fornices. The quantity of fluid used is regulated simply by the number of times the pad of lint is thus squeezed out, varying from five to thirteen times, according to the condition of the conjunctiva. The smaller quantity is but mildly irritating to the most delicate conjunctiva, whereas the larger amount is insufficient for some of those much altered by, or recently treated for, chronic inflammation.

INITIAL STEPS.

The ten-minutes cocaine period being up, the patient must be lying on a suitable table* or bed, or reclining on an operating-chair. The eyelids are squeezed together, with their conjunctival surfaces in contact, and any Meibomian secretion that is expressed is removed by the assistant with lint dipped in perchloride.

> From some rather thickened eyelids a considerable amount of milky or thick yellowish Meibomian secretion may be easily squeezed out, which is otherwise liable to be forced out during the operation, when it may be seen floating on the fluid used for irrigation. It is quite likely to contain pathogenic organisms.

The lids are then everted and moved freely on each other and on the eyeball, while normal saline solution is dropped upon them from the irrigator, to detach and wash away the mucus that one expects to find, mostly in the fornices, in response to the perchloride irrigation. If the mucus is large in amount, or if it is replaced by membrane covering the lids, the irritant solution has probably been too freely used. If, on the other hand, there is little or no exudation, the solution is again dropped into the conjunctival sac as before, from one to five times according to the state of the conjunctiva. Even this addition may fail to produce any appreciable secretion of mucus, removable by the curette at the end of the operation. In cases of cured stricture of the nasal duct, a trifle more lotion is used than would be otherwise indicated.

* The surgeon's hands work most naturally and steadily with horizontal forearms. An ordinary domestic table, with a single low pillow, usually places the patient's head at a convenient level.

The irrigator is in the charge of a special assistant placed on the opposite side of the patient to the chief assistant; the latter stands on the same side as the eye to be operated upon. It is the duty of the former to drop the fluid from the irrigator on the cornea in all the intervals between successive steps of the operation. He must be careful to avoid (1) letting the sterilized nozzle of the tube touch the surgeon's fingers during the operation, and (2) allowing the solution to spray over the patient's face at any time. In one of our cases a considerable loss of vitreous resulted from spasm of the orbicularis, excited in this way.

It has been suggested to me that irrigation of the surface of the globe is likely to carry micro-organisms into the wound. This appears scarcely possible with the sterile solution as it leaves the surface of the cornea. But if the fluid be allowed to accumulate in quantity in the conjunctival sac, one can imagine, especially with a sunken eyeball and with the speculum raised, that Meibomian secretion might float up to the wound, possibly with organisms also from the fornices, supposing there were any not imprisoned in the mucus produced by the perchloride. Hence some care is taken to prevent accumulation of the solution, by tilting the patient's head to one side at times.

The speculum is then inserted, and the outer eyelashes of the upper lid, beyond the blade of the speculum, are cut off with scissors unless the eyes be so prominent that the blade of the knife is not likely to touch the lashes while making the incision. And the eye is at once moistened with a stream of fluid from the irrigator. The patient must then look down towards one of his hands held up.

The eyelashes should touch nothing that has to enter the wound, as it is impossible to sterilize either them or the lid-margins; however, it is unnecessary to cut away any but the outermost lashes. Even the stumps left are likely to touch the blade of the knife if care be not taken while the incision is being made.

The muscular sense is sufficient to indicate to a blind patient the position of his hand. With the sunken eyeballs of very

thin people more complete rotation downwards is required than when the eyeballs are prominent.

The blades of the speculum, forced down on the eyeball by spasm of the lids, are the means of producing some large vitreous losses. But the responsibility is shared by (1) insufficient preliminary schooling of the patient, (2) unreadiness of the assistant in elevating the speculum on completion of the section, and (3) imperfect action of the cocaine. Some patients feel a little pain when the iris is rubbed or seized, whereas other eyes are rendered completely anæsthetic. The accident, with due care, is not sufficiently frequent to necessitate any alteration in design of the instrument at the cost of its convenience, still less its rejection in favour of elevation of the upper lid by retractor or by the finger.

To minimize the tendency to spasm of the orbicularis during the operation, the fellow-eye should always be kept open, even if blind from cataract. A few excitable patients, who at the start show a tendency to forcibly shut their eyes, are made to keep their mouths opened also. The connection here may seem strained, but giving them something to think of in this way undoubtedly appears to help them to keep quiet. The patient must not be allowed to answer by word of mouth to orders given, otherwise he is apt to substitute this to some degree for perfect compliance with the directions given. It is well that the orders should be delivered as much as possible by the chief assistant, who stands in the position towards which the eyes have to be turned. Nervous patients, especially those blind in both eyes, feel a natural inclination to look towards the person who issues the commands. Frightened people sometimes behave better during the actual operation if the preliminary lid-manipulations have been done a trifle roughly; the comparative quiet and gentleness are then by contrast reassuring. The lid-manipulations are of use also as a test of the patient's self-control, often warning the surgeon of the need of special care and watchfulness. If the hospital arrangements are such that patients waiting for operation are close at hand, within (sight and) hearing, it is most important to begin with the more docile and intelligent ones of the batch, and to keep the less reliable ones to the last. The quiet behaviour of the earlier patients has a most calming influence on the remainder; on the other hand, trouble with a stupid person at the start may alarm

the whole batch. One would expect, in operating on the second eye of a patient a fortnight or so after the first, to meet with quieter and more reasonable behaviour, but I have generally found the patient rather more nervous and excitable. At one time in our work chloral and bromide were administered to nervous patients beforehand. It might still, perhaps, be of use in exceptional cases, in addition to the training of the patients, which has now replaced it.

In spite of the trouble frequently experienced in getting the patient to do exactly what is wanted in the operation under cocaine, general anæsthesia* is much less satisfactory. Much more time is taken up, and unless the patient be well under the influence the eyeball is rotated upwards, and afterwards there is the chance of prolapse of iris or vitreous from vomiting.

In thin patients the weight of the speculum is apt to draw the lower lid back behind the lower orbital margin. When this happens the speculum must be raised again, both to prevent it pressing on the eyeball and to make room for the fixation forceps.

Ordinary daylight affords sufficient illumination except on very dull days; it ought to come mainly or entirely from one direction, to avoid the multiplication of obscuring corneal reflexes. Reflected sunlight from below is very dazzling, hence the advantage of a northern aspect. Concentrated artificial illumination in some form is very satisfactory in dealing with some of the later results—after-cataract, but is very rarely necessary for extraction operations. A slight disadvantage connected with it is the addition of another hand near the patient, required for its management.

The air in Bombay being neither particularly dusty nor smoky, the windows of the room are kept widely open, unless there happens to be a strong wind blowing.

The above measures apply equally to all the modifications for the operation for cataract extraction. A full

* From January 1, 1900, to July 31, 1902, in 1,374 extractions (linears excluded) chloroform was only used once on account of stupidity, and once because of want of control at an early age (thirteen years). Five times it was used for painful extractions in subacute glaucoma.

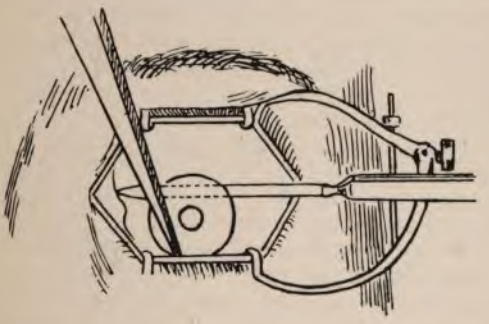
description will now be given of *combined* extraction—*i.e.*, with iridectomy. The lens is expressed through a wound lying along the upper corneal margin, the lens-capsule being cut or torn and left behind. This may be regarded as the standard method of extraction, since in many cases it is the only operation at all suitable, and many surgeons perform it exclusively. It is especially the operation for beginners. Later on the advantages and drawbacks in particular cases of (1) *simple* extraction without iridectomy, and of (2) extraction *within the capsule*, will be discussed. Finally, in Chapter V. the *linear* extraction of soft cataracts will be briefly described.

THE 'COMBINED OPERATION.'

THE CORNEAL SECTION upwards raises a flap consisting of rather less than half the cornea, and encroaching very slightly on the sclerotic ($\frac{1}{2}$ millimetre) all around, and it includes a conjunctival flap 3 or 4 millimetres deep at its summit. The surgeon stands behind the patient's head, and cuts with the right hand for the right eye, the left hand for the left eye, the other hand being occupied with the fixation forceps. The little finger of the cutting hand is supported against the patient's temple, the handle of the knife being grasped between the thumb and either two or three finger-tips.* The other hand rests steadily on the patient's face. With the forceps a firm hold of the conjunctiva is taken immediately below the cornea; the eye is neither pulled

* The exact mode of holding the knife is not of great importance. Some operators prefer to use only the tips of the fingers; others obtain freer movement by allowing the handle to rest against the index-finger, as in writing with a pen.

into place nor pressed upon,* but merely retained in the position which it has taken up. The point of the knife is inserted on the temporal side about 1 millimetre above the horizontal meridian of the cornea, and the direction of the blade is changed as little as possible in passing slowly across the anterior chamber. The plane of the blade needs to be altered only when the anterior chamber is shallow. The point enters the posterior surface of the cornea about $\frac{1}{2}$ millimetre within its visible (anterior



surface) margin, in order to make the counterpuncture emerge in scleral tissue. It must be distinctly realized that the counterpuncture constitutes the beginning of the incision; there must be no trace of hesitation after making it. The knife must at once cut upwards with a free sawing movement, without hurry, yet without delay, lest the iris come forward and overlap the edge of the knife, especially in eyes with shallow anterior chamber. But the completion of the cutting should

* The beginner is very apt to unwittingly press with the forceps on the eyeball while his attention is given up to the making of the incision, and to thus force out aqueous and iris through the wound.

always be accomplished quite leisurely; if the knife be allowed to come through with anything of a jerk, the patient may wince and try to close his lids. Towards the end the edge of the blade may have to be turned slightly forwards, and for cutting through the conjunctiva completely forwards. Care must be taken that the blade does not touch the stumps of the eyelashes at the temporal side, and that the point of the knife does not prick the upper lid or the side of the nose.

The right-handed beginner should be in no hurry to cut with his left hand as above described. Though it is unnatural to cut away from one's self, as one must do with the right hand on the patient's left eye (the surgeon standing at the patient's side), it can be done at once, without the practice that is required for the use of the left hand. One's attention is at first quite fully occupied in making the incision properly even on the right eye.

Before beginning the incision the grip of the fixation forceps is tested by a pull on the eye, to see that merely a loose fold of the frequently inelastic senile membrane has not been seized, with no restraining influence on the movements of the globe. Occasionally the grip of the forceps raises a narrow fold of conjunctiva, overlapping the inner margin of the cornea. This should be avoided by altering the position of the forceps, lest it interfere with the accurate locating of the counterpuncture.

It is quite impossible throughout a long series of cases to make the incision always exactly as one wishes. Variations creep in, owing at times to restlessness of the patient, or to the counterpuncture being wrongly judged, or to hurry in cutting upwards to avoid the iris, or possibly to individual peculiarities in thickness of cornea and in fixity of adjoining conjunctiva. As a result the section may come to lie in part distinctly within the corneal margin, or, on the other hand, it may be too deep,* including a conjunctival flap from the very beginning of the incision, especially on the nasal side. It is only with a chronically inflamed conjunctiva, perhaps insufficiently treated, and

* The incision commonly encroaches rather more on the overlapping sclera at the summit of the incision than at the side. This is necessitated by the formation of the conjunctival flap above.

possibly still containing pathogenic bacteria, that one desires a very complete conjunctival flap, as a special precaution against infection of the eye. Blood from under such a flap rapidly finds its way into the anterior chamber, and requires to be repeatedly washed away. It any case it is very difficult to regulate exactly the extent of a conjunctival flap.

Any considerable alteration in the plane or direction of the blade as it passes through the anterior chamber, or partial withdrawal to release the point caught in the iris, is likely to cause premature escape of aqueous. But the site of the counterpuncture must be always carefully judged, and corrected once or twice if necessary. It must be borne in mind that there is absolutely no occasion for hurry in making the incision until the aqueous begins to flow, which is ordinarily on completion of the counterpuncture. At this early stage of the cutting, delay brings forward the iris in front of the knife, especially when the anterior chamber is already shallow, or if the eye be pressed upon by the fixation forceps. Delay may be due to movements of the eyes, restrained, but not entirely prevented, by the forceps, or to spasm of the orbicularis, or to tearing of the conjunctiva by the forceps. It is of little consequence except in that it renders the completion of the incision a little painful, and an iridectomy thus made with the knife is either larger than required, or incomplete and irregular, leaving the pupillary zone of iris uncut. Sometimes the iris is not actually cut by the knife, but scraped and rubbed by it. This necessitates an iridectomy where a 'simple extraction' had been contemplated.

Bold sweeps of the knife, to utilize the greater part of the blade in cutting, are avoided because, except with eyes unusually prominent or exceptionally well turned downwards, it is difficult to be sure that the blade is not touching the stumps of the outer eyelashes, or the point pricking the inner end of the upper lid or the nose, while one's attention is given up to cornea and iris. No portion of the blade that has once touched the lid-margin should be allowed to enter the corneal wound. When there is a much-contracted palpebral aperture from former trachoma, it may be impossible to avoid touching the upper lid-border in completing the section, however well-behaved the patient may be. In three instances I have had to divide the outer canthus (with scissors at the time of the

cataract extraction) to get room for the play of the knife. The conjunctival fornices may be also much contracted by scarring; the scanty conjunctiva may be so stretched with the speculum as to fix the eyeball and prevent free rotation downwards, and to render it impossible to seize the tense ocular membrane with the fixation forceps. These difficulties make one very dependent on the correct behaviour of the patient.

In any case where a portion of the blade has become soiled by contact with eyelashes or lid-margin, a most helpful practice is to combine a rocking motion with the ordinary sawing movement of the knife; the incision can be completed by very short thrusts up and inwards, and withdrawals up and outwards.

The depth of the corneal flap need not be absolutely fixed; a rather smaller opening suffices for lenses with soft or fluid cortex. But the guiding principle must be firm in one's mind that too small an incision is much more harmful than too large a one. Provided the flap does not in the least exceed the semicircle it will be sufficiently well nourished, and safe. (See remarks on the 3-millimetre flap in Chapter III.)

It is especially in eyes with shallow anterior chambers that beginners are apt to 'split the cornea' for a considerable distance in making the puncture; they may fail to notice the lack of the mobility and of the lustre of the blade which indicate its entrance into the anterior chamber. The inner opening may thus be quite small compared with the surface dimensions of the flap.

It remains only to notice the rather humiliating contretemps of finding that one has introduced the knife with its cutting edge downwards, necessitating the postponement of the operation for a day or two.

The speculum is now at once raised by the assistant, and ever afterwards kept elevated as steadily as possible if there is the least tendency to spasm of the orbicularis. If any blood finds its way into the anterior chamber from under the conjunctival flap, it should be washed out before it has time to clot, and the conjunctival flap may be turned down over the cornea to prevent refilling of the chamber.

The nozzle of the irrigator should usually be passed into the anterior chamber by the surgeon laterally, and not at the summit of the wound, since uncontrolled movements of the eyes are practically always upwards.

THE IRIDECTOMY is easily made in quiet patients, with the eye turned down. The iris forceps held in the left hand are introduced closed at the summit of the wound. They are opened just enough to take a small hold of the iris a little nearer to its pupillary margin than to its base; and the fold of iris, slowly drawn out, is snipped off with the scissors resting on the wound, the blades pointing directly upwards at right angles to the line of the wound. Both hands are firmly supported on the patient's face. No more iris is cut away than is necessary to include the pupillary margin. In this way as little as possible of the sphincter is removed; this is one of the chief safeguards against subsequent prolapse or incarceration in the wound.

The conjunctival flap is rather in the way. Either it may be turned down over the cornea before the iris forceps are introduced, in which case it may debar one from seeing the points of the forceps as they grip the iris. Or the flap may be lightly pushed aside from the drawn-out iris with the points of the scissors just before cutting. Or if it is an extensive flap, a little of it may be cut away with the iris. If the conjunctival flap turns out to be deficient on either or both sides, while at the same time the pupil tends to elongate, and the iris to slip out of the wound, somewhat obliquely, and if perhaps also the patient tends to jerk the eye upwards, it may be convenient and permissible to perform the iridectomy a little to one side instead of straight upwards.

In attempting to remove as little of the sphincter as possible, one is very apt to buttonhole the iris, leaving a band of tissue separating the coloboma from the pupil. This is more likely to happen if the iris prolapses on completion of the corneal section, as occasionally happens; the iris is then likely to be

seized too near its base. The bridge of undivided tissue, if very narrow, often gives way under the pressure of soft cortex as soon as the capsulotomy is done. Otherwise it may be hooked out of the wound for division on the point of the cystotome; or if this prove awkward, a Tyrrell's hook, rapidly sterilized in the flame, may be introduced to pull it out.

Except with very quiet patients it is desirable that the assistant should fix the eyeball with forceps while the iridectomy is being made. In operating on the right eye he can do this with his right hand, while elevating the speculum with his left, and yet not be at all in the way of the surgeon. But in reversing the process for the left eye, an inexpert assistant may be able to accomplish very little with the forceps in his left hand, and so must use his right hand alone, either for fixation or to keep the speculum raised, according to the needs of the individual case.

Both the seizure of the iris and its section are often a little painful. It may prove advisable to instil a little more cocaine, and to wait for a minute or two with the speculum removed, in order to render the iridectomy painless. It is now and from this time onwards that the patient's self-control may evaporate largely, and fixation downwards be difficult to sustain. Very much, however, may be done in quieting the patient by a few words of encouragement. Should he perchance become uncontrollable, it may be wise for the remainder of the operation to dispense with the speculum, and to make use of a Desmarres' lid-retractor for the upper lid, and the assistant's finger to depress the lower lid.

It is somewhat surprising that the section of the healthy iris should give rise to no hæmorrhage. One reads of bleeding from the iris, but, except in complicated cases, one practically never sees it; the blood which fills the anterior chamber comes almost always from subconjunctival vessels. Dr. Powell tells me that he frequently had hæmorrhage from iris in cases where he had instilled eserine before operation.

THE CAPSULOTOMY consists ordinarily in a simple vertical incision of the anterior capsule, made with a Graefe's cystotome introduced a little beyond the lower edge of the pupil. Any attempt at a T-shaped or V-shaped

opening of the transparent elastic capsule means simply a widening of the opening first made.

The eye may, or may not, be held by the assistant with fixation forceps. The cystotome, grasped in the surgeon's right hand, may be steadied against his left forefinger. If there appears to be any chance of the eye rolling upwards, the cystotome is best entered horizontally from the side—from the nasal side in operating on the left eye, from the temporal side on the right eye.

When there is but little soft cortex, as in hypersclerotic lenses and in some over-ripe cataracts, the pressure of the cystotome may tend to dislocate the lens backwards, rupturing the suspensory ligament, or its point may stick in the firm lens-substance, and so pull the lens upwards with the movement of the cystotome.

If the point of the cystotome be buried in a layer of blood lying in the anterior chamber—as it must often be when a conjunctival flap is made use of without irrigation of the anterior chamber—the chance of accidents is much increased by the surgeon being unable to see whether the capsule has been perforated or not.

(For the management of the opaque capsule of over-ripe cataract see Chapter III.)

THE DELIVERY OF THE LENS is accomplished thus: The conjunctiva below the cornea is seized with the fixation forceps held in the surgeon's left hand, and the globe is pulled downwards, with a little pressure backwards, until the wound gapes. The edge of the tortoiseshell spoon is then laid on the lower edge of the cornea and pressure backwards gradually applied and the forceps removed. To assist in the movement of the lens upwards the spoon pressure should be alternately towards its end and along its curve, but the spoon should not, as a rule, follow the lens upwards till the latter has fully entered the wound. In this way one secures that the cortex shall move up with the nucleus, and be evacuated with it as much as possible. When the lens is half out of the wound the

forceps are held ready behind it, to push it to one side if the eyeball should roll upwards. Any remaining cortex is usually easily washed out by the surgeon with the irrigator, unless it is unripe. Ribbons of soft cortex may be left extending in from the periphery, which may resist moderate efforts at displacement with the stream from the irrigator. These refractory sectors may be started on their way by light intermittent jerky pressure with the back of the spoon on the margin of cornea* nearest to them; once they have begun to move they are easily washed away. But a few narrow thin bits left in the periphery are not of great consequence. If extraction of a very unripe cataract with transparent cortex has been attempted, and a quantity of cortical matter left, prolonged attempts should not be made to remove this sticky substance. One must depend on rapid dilatation of the pupil afterwards, leaving the matter to be absorbed. It cannot be too strongly insisted upon that pressure and manipulation for the evacuation of lens or cortex need never be other than very gentle, if properly directed, and if the sources of difficulty are sought out. Heavier pressure for unripe cortex is much more likely to rupture the zonule or posterior capsule than to move lens-remnants that have resisted lighter efforts.

The delivery of the lens should ordinarily be the slowest part of the operation, but a few lenses with soft cortex and small nuclei are pressed out quite independently of the surgeon (apparently by elastic sclerotic or overfull vitreous). And on rare occasions the operation may be finished in a very undesirable fashion, either on completion of the section or of the iridectomy, by sudden spasm of the eyelids forcing out the lens in its capsule together with a quantity of vitreous.

* Pressure may thus be made over the site of the wound without danger of the spoon slipping within it, on movement of the eye, if the extremity of the spoon be kept pointing upwards, and its shaft lying over the centre of the cornea.

Cortex which is exceptionally slow of absorption is the cream-coloured, consistent, equatorial ring of the typical over-ripe, disc-shaped cataract; but this is almost never left behind, except when there is escape of vitreous.

Difficulties in expelling the Lens.—Leaving out of consideration difficulties from too small a corneal section, which should never be experienced, and those arising from definite over-ripeness of the cataract (dealt with later), there are occasional instances where the lens does not enter the wound as one expects.

Firstly, there are the cases where the lens has been pulled upwards by the cystotome, so that its upper margin lies *behind the upper lip of the wound*. On pressure being applied the cornea may bulge forward unevenly and quite independently of the lens, which remains fixed. As soon as the nature of the trouble is recognised, it is a simple matter to push the lens down into its place with the cystotome, and afterwards to depress the upper lip of the wound with the curette, while the edge of the lens is tilted forwards by spoon-pressure on the lower third of the cornea. Without this reposition, the origin of the difficulty being unrecognised, an attempt at introduction of the vectis behind the lens may cause the latter to revolve on its horizontal axis, the lower edge coming forwards and upwards to escape first, and there is likely to be loss of vitreous.

Then there are the cases where unnecessary pressure with the cystotome, its point hidden by blood in the anterior chamber, has *depressed the lens*, rupturing the suspensory ligament. As soon as this fault is recognised, the upper lip of the wound should be pressed back with the vectis or scoop, ready to be slipped in behind the lens if pressure on the globe should cause vitreous to protrude.

At other times, especially if working without an irrigator, and with the point of the cystotome buried in blood, the *capsule*, perhaps a little tough from slight over-ripeness of the cataract, may have been *opened insufficiently or not at all*. The lens, perhaps, moves a little on pressure, and then stops. A second introduction of the cystotome set matters right.

On other rare occasions the wound opens at once, and the *lens follows the cornea forward* and appears *to stick to it*, refusing to move upwards. The lens is small, thin, and discoid, and its anterior surface appears to become closely fitted into

the curve of the posterior surface of the cornea, with no air-space at any part; and the small size of the lens prevents a purchase being got readily upon it with the pressure of the spoon. The sharp edge of the lens can be seen, and behind it the vitreous, restrained by the stretched suspensory ligament, when pressure is put on the eyeball below. Care must be taken not to cause the wound to gape much, for fear of rupture of the zonule. The tortoiseshell spoon, instead of simply pressing backwards, must coax the lens upwards, following it on the cornea.

Occasionally for some reason, as for further instillation of cocaine in the eye of a restive patient, there is a break in the proceedings after the completion of the section, the speculum being removed. After quite a short interval, the *conjunctival flap* may be found *glued down by blood-clot* sufficiently to present an obstacle to the easy expression of the lens, and may require to be lifted up with forceps.

Vitreous Escape in ordinary extraction, without removal of capsule, may be due to fault of the patient or of the operator, or of neither. The largest losses are commonly the result of sudden spasm of the orbicularis in frightened patients, forcing the speculum down on to the globe. Even here the surgeon must accept some responsibility for the accident, since the behaviour of nervous patients at the operation may be sensibly modified by a little preliminary training, as well as by the surgeon's personal influence at the time. More often the accident is due to ill-advised pressure with the cystotome, or during the delivery of lens or cortical matter; or it may be due to special difficulties connected with over-ripeness of the cataract (see Chapter III.). It is predisposed to by a deep counter-puncture, necessitating too peripheral an incision and consequent loss of the support afforded to the suspensory ligament by the peripheral strip of cornea and by the sclerotic. It is tempting often to shelve the blame on to 'fluid vitreous,' but the excuse is inadmissible, except in some of the cataracts of young people,* or unless there is definite presumption of disease afforded by high myopia, inactive pupil, etc.

* Twice in children and once in a woman of twenty years, among our operations, the zonule gave way, and escape of fluid vitreous occurred on completion of the section, made in two cases by a Graefe's knife, and in the third by a keratome for linear extraction.

If it happens *before the lens* is out, it is a serious accident, necessitating the introduction of a vectis or scoop for the delivery of the lens. In rare instances this fails, the lens passing down into the vitreous. Once this failure happened to me in the case of a child, and once in an adult, the nucleus only in this case being thus lost, and fair vision resulting after a subsequent capsulotomy.

If, as is more common, the *vitreous follows the lens*, the chief immediate disadvantage is that little or no attempt can be made to remove cortex. The wound may remain distended by a prolapse of consistent vitreous, which can be cut with scissors; or, on the other hand, the corneal and conjunctival flap, after larger losses, may tend to fall in and be displaced under the sclerotic. Every movement of the eye is liable to force out more vitreous, so that only a very incomplete conjunctival toilet can, as a rule, be performed, and the two eyes must be bandaged up quickly, after seeing that the lips of the wound are as nearly adjusted as possible.

The wound may at times gape from hernia, or *prolapse of vitreous*, without actual loss. A narrow incarceration, covered with conjunctival flap, may be left to recede of itself; but a wide prolapse of consistent material needs partial excision, or expression after puncture.

Rarely after an ordinary uneventful operation, the wound *at the first dressing* may be found distended, and the upper part of the cornea bent forward, by vitreous. Or, after a perfectly satisfactory extraction of the lens within its capsule (see Chapter III.), the pupil may next day afford evidence (see below) of considerable loss of vitreous. From these rare evidences it may be assumed that other losses sometimes occur after operation, from spasm of the lids, or from the pressure of too tight a bandage, without ever being detected.

The Consequences of Loss of Vitreous.—In most cases there is next day no longer any evidence of the mischance; the healing goes on normally, and the consequences are *nil*. Very occasionally the wound remains open, with vitreous incarcerated in it. Though this slowly shrinks, great astigmatism is left, with a certain liability to bacterial invasion of the eye at any time. In other cases this invasion takes place quite early. There is little doubt that a wound occupied by vitreous is more prone

to infection* than the ordinary closed incision, more or less protected by conjunctival flap. When the wound heals normally, sight may by chance be directly obscured by cortex left embedded in vitreous and unabsorbed. Another fairly frequent effect is displacement of the iris. In slight losses the iris tends to lie in the wound incarcerated or prolapsed. Large escapes may lead to a curious and characteristic great enlargement and distortion of pupil,† which is the same whether an iridectomy has been performed or not. At the first glance one might think an enormous iridectomy had been done. The upper half of the iris has disappeared, retracted behind the scleral margin, and can only be seen, narrow, thin, and atrophic, by oblique illumination. Eserine has no effect on it. The pupillary margin of the lower half of iris arches across, slightly curved, somewhere about the middle of the cornea, to disappear at either end behind the sclera. This distortion of pupil, in my experience a certain sign of large loss of vitreous, makes one fear for the stability of such an eye, lest at any time *detachment of retina* should come on. This is the great cause of loss of vision after considerable evacuation of vitreous, but there are no statistics available to enable one to judge of the frequency of its occurrence, either soon after the operation or later.

Vitreous escape may rarely be the first indication of expulsive hæmorrhage from the fundus, entailing loss of the eye.

Among 1,484 extractions of all kinds, except 'linears,' at the Cowasjee Jehangir Hospital from January 1, 1900, to October 31, 1902, there were seventy vitreous losses—*i.e.*, nearly 5 per cent. Probably more than half of these losses were in operating upon complicated or over-ripe cataracts.

Sometimes after expulsion of the lens the wound remains

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* See *Indian Medical Gazette*, xxxvi. 210.

† This not very uncommon result of large loss of vitreous appears to have attracted little or no attention hitherto. Pope refers to it in the *Indian Medical Gazette* for June, 1901, without apparently realizing the exact condition. Treacher Collins has described a ismilar result from a concussion injury, and in the *Practitioner* for September, 1902, mentions it in connection with the very rare 'retroflection' or 'inversion' of iris. It is difficult to understand why the retraction and atrophy of iris should be so sharply limited to its upper half. The iris does not seem to be bent backwards at all, as seen by following its pupillary margin (with focal illumination) at the sides, where it joins the lower unaffected portion.

a little open. This may indicate a tendency to prolapse of vitreous, as above, But much more commonly it is due to the action of the speculum, improperly supported, held in such a way as to allow some portion of the stretched upper lid to press on the eye. The outer portion of the lid-margin beyond the blade of the speculum may sometimes be seen to rest on the globe, and a slight movement of the speculum outwards relieves the condition. At other times bringing the upper blade of the instrument, together with the upper lid, a little further forwards is required to properly adjust the lips of the wound.

On the other hand, in old people the inelastic sclerotic may fail to contract on the reduced contents of the globe, the cornea consequently falling backwards to form a deep cup, after evacuation of the lens. Any cortex left is but little influenced by pressure applied to the eye, and for its removal depends almost solely upon irrigation, the excess of saline fluid being afterwards expressed from the anterior chamber. The lens is generally of the purely shrinking variety, with rather deep anterior chamber, and the broken ring of soapy cortex is quickly washed away. (One wonders whether in these cases the vitreous may not be also, like the lens, a little shrunken, and whether this shrinkage may not partly account for the falling in of the cornea.)

Using a conjunctival flap regularly, I have given up the rough visual test of asking the patient to count fingers at the close of the operation, looking through a lens, because of the frequency with which the sight is obscured by blood in the anterior chamber. The test affords no information with regard to capsule or lens remnants that may not be got from inspection in a good light, except in operating on very unripe cataracts, when possibly transparent cortex, not readily seen, may be left.

Rarely one finds, after extracting a cataract of the shrinking type, possiby unripe, that there is a faint *central opacity* left on the *posterior capsule*, diffuse or in the form of an indistinct ring. I have always, when I have met with it, punctured this opaque capsule with the cystotome. There has never been a large escape of vitreous, and seldom any at all.

TOILET OF THE EYE.*

The pillars of the coloboma are pushed together by the curette introduced into the wound at either side; this serves also to reduce any possible entanglement of transparent capsule between the lips of the wound. Blood-clot adherent to the wound may be removed with iris forceps; but any blood now collecting in the anterior chamber is left to be absorbed. The conjunctival flap is then smoothed out, and the speculum removed. With the lower lid firmly depressed by the assistant, the surgeon gently passes the curette over the whole of the conjunctiva of both lids, to remove any mucus that may have accumulated during the operation, while the conjunctival sac is washed out by the irrigator.

The curette used in this way often produces rather a sore feeling, and care has to be taken not to occasion contraction of the orbicularis. The lower lid is especially looked after, because its pressure on the eyeball must tend to lever the wound open, whereas spasm of the upper lid tends rather to close it. The eyelashes of the upper lid are seized to raise the lid for the passage beneath it of the curette, the patient looking downwards. I have never known any accident from this cleansing of the conjunctiva. The curve of the curette is kept forward, so that the point of the instrument cannot by chance enter the wound in the eyeball.

THE DRESSING AND AFTER-TREATMENT.

The eyelids are gently closed by the surgeon, and covered with a pad of dry boric wool on a layer of gauze, and the pad is fixed by a simple bandage. A shield is applied all over.

* The evacuation of cortex is ordinarily included as part of the 'toilet of the eye,' but it seems better placed with the delivery of the lens.

The patient is not told to close his eyes himself at the end of the operation; he is apt to do it much too vigorously. Except in special cases, as after vitreous escape or when iridectomy has not been performed (see later), the fellow-eye is not bandaged, but is simply covered with a piece of lint hanging down over it. Various methods of bandaging have been tried, but the simplest has suited us best, as it is not easily removed nor displaced by the patient, and aids in the fixation of the shield. We employ an ordinary calico bandage, 3 inches broad, long enough (2 yards) to go thrice around the head; the first and third turns pass over the forehead firmly, the middle one alone goes below the ear and over the eye, and is not drawn tightly. Calico is selected as the cheapest, not the most suitable material. Where conjunctival irritation from perchloride is rather marked, keeping the bandage and underlying pad moist, by dropping boracic lotion every few hours for the first day or two, is grateful to the patient and tends to limit the reaction; but the pad of absorbent wool is not moistened before it is applied to the eye, because its elasticity in the dry state is required to control and distribute the pressure of the bandage when applied. For a shield a broad open wire cover is used over both eyes, fixed by tapes around the head, and also by safety-pins to the bandage. It would be simpler and cooler to substitute strapping instead of the bandage, to fix both pad and shield, if the patients could be depended upon to leave them in place.

The patient is carried to bed on a stretcher, if the operation has not been performed on his bed. He must expect a little soreness of the eye for a few hours. It has been our practice to keep the eye bandaged for five days, or even longer when the healing has been complicated. But every day the coverings are removed for inspection of the eye and for washing of the lids. It is most important to examine the condition of iris and pupil with focal illumination* the day after operation. It is only

* Such light as is given by Priestley Smith's candle lamp is not sufficient; it must be focussed with a separate lens, as in the ordinary dark-room examination.

thus that the effects of reaction to traumatism can be rendered transient and innocuous, and the onset of iritis regularly and systematically controlled. In few of our cases is atropine entirely withheld, and in a fair number the question to be determined for the first few days is how much atropine the patient can stand, rather than how much is required (see pp. 71 and 73).

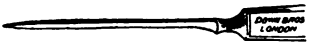
The patient is ordinarily enjoined to lie only on his back and on the side away from the eye operated upon; he is kept recumbent for a couple of days. But for special reasons, as in severe chronic bronchitis or in very old people, the sitting or semi-recumbent attitude may be maintained from the beginning. There should be no muscular effort made, as in rising unassisted from the bed, and no straining at stool. The diet should be soft, requiring no chewing, as long as the bandage is in place.

The light in the room is kept rather dim. This is preferred to ordinary daylight by the patients, and is only reasonable where so many pass through at least the earliest stages of iritis; while the depressing mental influence of a very dark room is avoided. After the bandage is taken off, a large shade is worn for protection both against injury and against light. And on discharge from hospital, smoked glasses are worn as long as any ciliary injection remains.

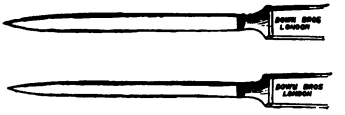
At the daily washing of the lid-margins, generally required for the removal of mucus, possible ill-effects from spasm of the orbicularis are avoided by keeping the lower lid pulled well away from the eyeball.

Ordinary patients are given plain spherical glasses on discharge from hospital, if they have come from a distance; but they are warned not to wear them for some time. When the patients can afford to buy better spectacles, these are prescribed two months after operation. After this period there is little further change in the degree of astigmatism which, often great a few days after operation, diminishes gradually for some weeks. The permanent vertical flattening of cornea

PLATE I.

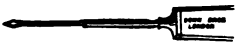


OLD GRAEFE'S KNIFE.



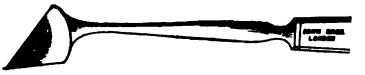
GRAEFE'S CATARACT KNIFE.

CUTTING NEEDLE.

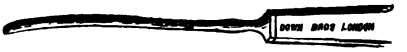


BOWMAN'S STOP-NEEDLE.

TYRRELL'S IRIS HOOK.



JAEGER'S ANGULAR IRIDECTOMY KNIFE.

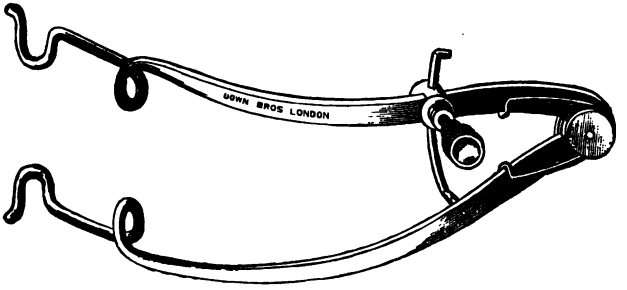


MOORFIELD'S PATTERN EYE-CURETTE.

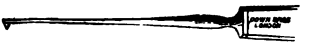
TAYLOR'S VECTIS.

Plates I.—IV. to face p. 46.

PLATE II.



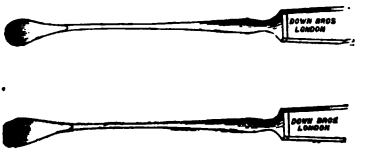
CLARK'S EYE SPECULUM.



GRAEFE'S STRAIGHT CYSTOTOME.

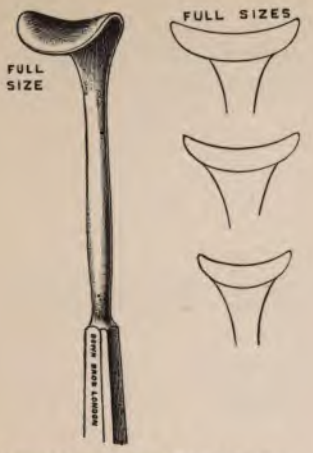
GRAEFE'S CURVED CYSTOTOMES, RIGHT AND LEFT.

TORTOISESHELL SPOON.

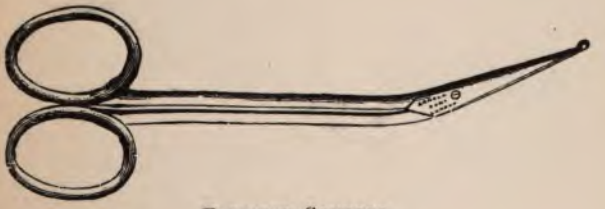


CRITCHETT'S DOUBLE SPOON.

PLATE III.



DESMARRE'S LID RETRACTOR.

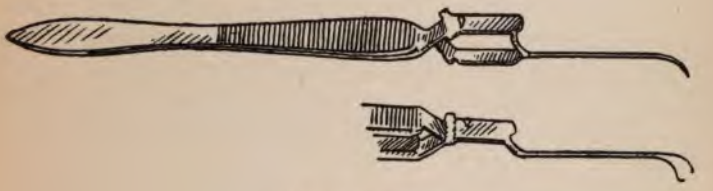


ELBOWED SCISSORS.

STRAIGHT SCISSORS.

PLATE IV.

De Wecker's Iris Scissors.



Iris Forceps.

Fixation Forceps, Ordinary Pattern.

Iridectomy Forceps.

left by our operations varies usually from *nil* to 3 or 4 dioptres. The axis of the correcting cylinder is given quickly and accurately by the astigmometer; it is usually 'parallel to a line joining the points of puncture and counter-puncture.' The spherical correction — about + 10 to 12 D for distance, with + 4 or + 5 D added for reading, in the previously emmetropic eye—with any needful cylinder added, enables us to classify the resulting vision by a commonly accepted standard. A 'good' result generally means V.A. $\frac{6}{60}$ or upwards; lower than this, but with ability to count fingers at ten or more feet, is classed as 'fair.' Occasionally $\frac{6}{5}$ is obtained, but it appears to be more by luck than by management.

Since the astigmatism is not fully neutralized by cylindrical lenses, it is important to have as little of it as possible. It may be enormous in some cases of prolapse of iris or vitreous. In uncomplicated healing it appears to be due to over-riding of the corneal flap. It is less marked with a scleral incision and conjunctival flap than with a purely corneal incision; the less peripheral the section, the stronger the astigmatism (Majewski, *Annales d'Oculistique*, cxxvi., 99). And probably the size of the wound influences the degree of flattening.

If the fellow-eye still have good vision, no glass is given for the eye operated upon, because the two eyes —the one with accommodation, the other without— cannot work together. Thus, the only immediate gain is a return of the visual field to normal, with perhaps the restoration of stereoscopic vision. If the vision of the other eye be impaired by commencing cataract, the result of careful correction of the two eyes must decide which shall be used for fine work. Where the other eye has been lost from any cause, the spectacle frame is often made reversible, to hold both a distance lens and a reading lens.

CHAPTER III

DISCUSSION OF OPERATIVE TECHNIQUE AND OF ALTERNATIVE PROCEDURES

Antisepsis—The Corneal Section—Preliminary Iridectomy—The 'Simple' Operation, without Iridectomy—Capsulotomy—The Evacuation of Cortex—Over-ripe Cataracts—The Open Treatment of Wounds.

ANTISEPSIS by irrigation with antiseptic fluids is rather out of fashion at the present moment. It has been shown that immediately after the use of these solutions the conjunctival sac may be by no means freed of living bacteria, and the reduction in their numbers may be scarcely greater than can be effected by mechanical cleansing with normal saline. Hence the conclusion that antiseptics are useless and harmful, because irritating—a conclusion which conflicts with the slowly accumulating, but as yet ill-formulated and disjointed, clinical evidence of the value of antiseptics in reducing the number of grave infections after operations. The fallacy lies in overlooking the detail that a little time is required for the action of the antiseptic solutions; they do not ordinarily kill the micro-organisms, but *assist in their removal.* Strong perchloride in virtue of its *irritating* and *coagulating* properties produces in normal and nearly normal membranes a rapid secretion of

mucus, with shedding of the superficial epithelium, so that after the ten-minutes cocaine interval the accumulated result is ordinarily seen in readily removable flakes of mucus lying in the fornices, with possibly a trace of membrane formation over the tarsi. Here we have an obvious explanation, on the one hand, of the way in which micro-organisms may be protected against the germicide action of the lotion, being embedded in this mucus, and, on the other hand, of a ready means of removal of the organisms, by simply washing away this accumulation. In thickened and roughened or scarred conjunctivæ, the formation of mucus may be very scanty or altogether wanting; possibly here the antiseptic is able to attack the microbes directly.

> I have never carried out any series of bacteriological observations to test the sterility of conjunctivæ thus treated. However, in a few cases of active trachoma lately, at an interval after very free perchloride irrigation, I have found expressed follicular material to be quite sterile, whereas ordinarily it is always contaminated with surface organisms. On the other hand, that the quantity of perchloride used in our cataract operations may be sometimes insufficient to clear away all the organisms has been indicated by a slight perceptible liability for prolapse of iris or of vitreous to be complicated with irido-cyclitis. The clearance, possibly sufficient for the healing of well-adjusted wounds, was not always complete enough for the protection of wounds containing prolapsed iris or vitreous.*

Whether this explanation be true or not, there is no doubt of the clinical fact of the protection afforded by strong perchloride, used as already described. My own statistics of operations performed at the Cowasjee Jehangir Hospital up to the end of January, 1901, published in the *Indian Medical Gazette* for June, 1901, sum up thus:

* See *Indian Medical Gazette*, xxxvi. 210.

1. With 1 in 3,000 sublimate lotion freely used there was a series of 497 extractions completely exempt from grave infection.

2. With the same fluid rather more sparingly applied, in 578 extractions there were—besides two severe late inflammations, with no bearing on the question at issue—three grave primary infections, which stopped short of panophthalmitis.

3. Where not only the quantity, but in most instances the strength also, of the antiseptic was reduced, panophthalmitis followed thrice in 349 operations, and there were seven closed pupils from iritis or irido-cyclitis (it was thought probable, however, that some of these occlusions might have been prevented by a freer and earlier use of atropine).

Since the above date the strong sublimate lotion has been used more freely and regularly after the cocaine installation, in the cases where a sufficient formation of mucus had not followed from the routine irrigation before the cocaine period. Thus more accurate adaptation to the needs of individual eyes has been secured. And the results have been sufficiently gratifying. Up to November 5, 1902, 930 operations have been performed.* There has been but one suppuration, and I think I am right in saying there has been no infective iritis or irido-cyclitis severe enough to have resisted energetic treatment. The only cases qualifying this statement are here given:

> The one suppuration occurred during my absence on short leave, in an eye operated upon the day before my departure. The hospital assistant did not realize that anything was

* Private operations might have been added, but no definite record of them has been kept; there have been no bad results among them from infection.

seriously wrong with the eye for four days after operation; the bandage had come away during the preceding night. The eye had never been examined by focal illumination, as it should have been. There may have been infective inflammation from the beginning, at first controllable, but insufficiently treated until it had developed too far.

One patient had lost the use of her eye from neglected iridocyclitis ten months after operation. On discharge from hospital twenty-six days after operation the vision was $\frac{6}{60}$ with a spherical lens, and the presence of active mischief was unsuspected. There is every reason to suppose that, had the eye been properly cared for afterwards, the final result would have been good.

Another eye was lost from acute infective inflammation nine and a half months after operation, a late result of large prolapse of iris.

There were three eyes in which iritis helped to reduce vision to moving bodies only; but they were complicated cases, and the iritis presumably not infective. In one a very unripe cataract was extracted, partly for the cure of chronic glaucoma present, which had only been temporarily relieved by an iridectomy. A good deal of soft lens-matter was left in contact with the iris, keeping up irritation. Nearly a month after the operation catarrhal conjunctivitis attacked both eyes, associated with the presence of small bacilli—probably Weeks'. This appeared to add to the chronic iritic inflammation, and a small hypopyon was seen for a week. After the eye had quieted down an opening was made in the membrane then occluding the pupil and coloboma, but the vision was not improved thereby. It was thought that the tension was still slightly raised.

In the second case the nucleus of the lens was lost in the vitreous. The pupil and coloboma became occupied by thin membrane, which was divided three and a half months after operation, restoring the vision to fingers at 12 feet with +12 D.

In the third case, referred to on p. 90, acute glaucoma set in two days after operation from 'exclusion of the pupil,' brought on by the irritation of creamy lense-*débris* left behind the iris. Treatment was not sufficiently prompt, and, though the

patient went out of hospital thirty-nine days after operation seeing fingers at 12 feet with + 12 D, she came back a month later with the eye soft and pupil occluded.

This series of results is more encouraging than any hitherto published on account of its length, and because it includes the less intense infections together with suppurations. A run of 100 successful operations must be looked upon nowadays as an insufficient recommendation of any particular method, since 1 per cent. of grave infection is exactly 1 per cent. beyond the permissible, and the fate that afflicts us with casualties distributes them by no means evenly. My figures must be accepted as irrefutable evidence of the value of perchloride lotion, especially in dealing with chronically inflamed conjunctivas. The one suppuration has but little bearing on the question, from the circumstances connected with it. Excluding this case, the evidence is very strong that perchloride, properly used, should enable one to go on operating indefinitely without meeting with infective inflammation too severe to be controlled by treatment.

The drawback—but not a serious one—to the use of the strong lotion lies in the difficulty in graduating correctly the quantity required in each case, according to the state of the conjunctiva. If used in excess its irritant properties may be great enough to affect not only the surface, but to spread also in very slight degree to the deeper tissues, adding to the effects of the irritation of the iris by lens remnants, etc. One must be prepared to instil atropine a little more freely in the after-treatment than when no antiseptic has been used.

A strong case is thus made out for the routine preliminary antiseptic irrigation of the conjunctiva in Indian practice, where quite normal membranes are the exception. But in Europe, where but few conjunctivæ

contain pathogenic organisms, and where trained assistance is more generally available, ideal treatment would appear to require the determination of the presence or absence of dangerous microbes, and the limitation of the irritating application accordingly. Sufficiently long series of results of the strictly aseptic treatment of apparently normal membranes are not yet available to enable us to judge of its safety without the control of previous bacteriological culture tests.

With some surgeons aseptic treatment of the conjunctiva means swabbing with lint soaked in sterile salt lotion; with others simple douching; with others, again, no treatment at all. Without attempting to discuss the matter, it may be borne in mind that where no pathogenic organisms are present all cleansing measures are superfluous; and in old days, before antiseptic surgery was known, the percentage of eyes that showed the effects of microbic invasion was not extremely high.

Much trouble is taken by some surgeons to clean and disinfect the lid-margins and eyelashes. It seems better to recognise as impracticable the complete removal of cocci from these surfaces; and to realize also that it is unnecessary, judging from results, provided that contact of these surfaces with the parts of the instruments that enter the wound is avoided.

For antiseptic conjunctival irrigation any one particular strength of perchloride solution is not extolled as more suitable than others. The effect varies nearly as much with the quantity used as with its strength.

Daily antiseptic douching of a chronically inflamed conjunctiva is often an effective remedy for the abnormal condition. But, practised on a perfectly normal membrane, its irritant effect must set up a slight conjunctivitis, very soon associated with the presence of pathogenic cocci, as has been found after Credé's silver-nitrate treatment of the conjunctiva of the newly born.

A comparison of the conditions and surroundings of our patients with those obtaining in some of the elabo-

rately-fitted hospitals of Europe and America should prove profitable. At the Cowasjee Jehangir Hospital there is no operating theatre; the operations are performed in a room just cleared of the daily crowd of out-patients. The windows of the room are widely open; this seems sufficient to render of no account the daily soiling of floor, furniture, etc. But the conditions contrast well with the measures taken elsewhere to secure pure (filtered?) air and spotless surroundings. The patients themselves are far from clean, and no extraordinary effort is made, on admission, to clean even their eyelids, which may never have known the application of soap. Our attention is concentrated upon the conjunctiva, and upon abnormal secretion from the Meibomian glands, or rarely from the lachrymal sac, as the sole sources of the infective bacteria that may, in a fairly well-guarded and correctly-performed operation, possibly find their way into the wound. The above-detailed results certainly justify our practice. And a consideration of the conditions under which such exceptional results have been obtained should help to eliminate the useless and unnecessary from the elaborate array of precautions thought needful, more particularly by some of the exponents of strictly aseptic treatment (see, *e.g.*, McGillivray, 'Transactions of the Ophthalmological Society of the United Kingdom,' xviii., 320-338). An expenditure of energy wide of the mark can only obscure, and draw attention away from, the true seats of danger. A well-devised scheme must be based on a fairly definite conception of the real sources of infection, limiting and concentrating the measures taken. And it cannot be claimed that more elaborate defensive precautions should surround the completely aseptic methods than are found necessary in our work. For our actual opera-

tions are really aseptic, since no antiseptic is used during their performance. The preliminary washing of the conjunctiva with perchloride corresponds only with disinfection of the patient's skin in general surgery.

THE CORNEAL SECTION perhaps most practised at the present day corresponds exactly with the corneal circumference on the surface of the globe. But if a conjunctival flap is to be cut, the section must extend very slightly into the sclerotic. Additional advantages of encroaching upon this vascular tissue are (1) that healing is directly aided and hastened thereby, and (2) the wound is a trifle larger than a purely corneal opening, enabling the lens to escape more easily.

A fairly extensive *conjunctival flap*, covering in the wound and uniting with great rapidity, is of recognised value after the operation in guarding against prolapse of the iris and against invasion by micro-organisms.* And 'delayed union' of the wound is no longer met with. The one serious drawback of the flap is bleeding into the anterior chamber. This is so constant as to make the use of the irrigator an almost inseparable accompaniment. The more complete the flap, the more troublesome the hæmorrhage, so that, even with the irrigator at hand, it is advisable to confine the flap to the upper part of the wound, except in cases where pathogenic organisms are likely to be present in the conjunctival sac. The fashioning of the conjunctival flap need not entail any of the disadvantages of a too peripheral incision.

A *too peripheral section* involves (1) some liability to loss of vitreous, from lack of support to the suspensory ligament and hyaloid membrane, and (2) increased risk of subsequent pro-

* It does not, of course, remove the chance of infection occurring *during* operation.

lapse or incarceration of iris. With the latter must be included its possibilities in the form of infective inflammations, with sympathetic involvement of the fellow-eye. Iritis and iridocyclitis have been attributed also to bruising and rubbing of iris and ciliary body with the knife, but the effect of traumatism has probably been exaggerated (see p. 73).

A corneal flap ending *well within the corneal margin*, made by turning the edge of the knife forward, is preferred by some surgeons for 'simple' extraction, without iridectomy, owing to a reduced liability to prolapse of the iris. But the astigmatism from the section is commonly greater, and adhesion of the iris to the line of the wound seems more likely to lead to glaucoma later. And the advantages of a conjunctival flap are, of course, given up.

The unsuitability of the short *3-millimetre flap* for the extraction of large lenses is now well recognised. Formerly surgeons were inclined to keep the incision down to the lowest possible limit, hoping thus to lessen the risks of sloughing of the cornea, suppuration of the wound, and prolapse of iris. A truer understanding of the causes of the mishaps has taken away the fear of a larger incision. Often the wound had to be enlarged with difficulty by scissors, and there was much bruising of iris and of the lips of the wound in squeezing out the lens; cortex was more liable to be left behind; and escape of vitreous was more common, owing to the amount of pressure required to expel the lens.

A *downward section* may occasionally have to be used to suit an artificial pupil already made, or a congenital coloboma, or possibly in a stupid patient, who cannot be got to turn his eye down.

The practical advantage to be derived from a historical survey of the various incisions now obsolete, since Daviel's time, has been mostly included in the above remarks. The chief modifications in size and position of the wound have been mentioned. *Von Graefe's modified linear* operation served particularly to emphasize the evils both of too peripheral and of too narrow an opening. But it provided us with the most suitable knife for operation.

It remains to notice some special proceedings intended chiefly to aid in extraction without iridectomy, and hence l together:

Of the *corneal suture*, as applied to the ordinary wound for cataract extraction, I have no experience. But a limited acquaintance with the suturing of certain wounds in glaucoma operations has been sufficient to show its difficulties. To insert sutures at the close of the operation is practically impossible unless the eye be very steady and well turned downwards. Inserted before the incision is made, the previously sterile loop which embraces the wound is very apt to become soiled by contact with lid-margins and skin. It is decidedly in the way, and its application, by prolonging considerably the operation, enhances greatly the strain upon the self-control of the patient.

It was hoped that the suture would largely do away with both prolapse of the iris and infection of the eye; but Kalt's large experience of it has been somewhat disappointing in both these respects. With rather doubtful advantages it is altogether too troublesome a measure, except to meet unusual difficulties. For instance, in unintelligent patients, who refuse to look downwards, it might enable one to use a lower or lateral (Bourgeois) section with greater confidence.

Bourgeois' external lateral section, made with a special double knife, and combined with corneal suture, is ingenious; but the description does not explain how the second half of the incision is finished with an empty anterior chamber, without injury to the iris.

Subconjunctival extraction (Vacher, Pansier)—extraction performed under a conjunctival bridge, or flap left uncut at its extremity — appears to provide exceptional security against prolapse of the iris in simple extraction. Vacher records 120 extractions free from prolapse. But this is the only advantage not obtainable quite so certainly by other means. Hæmorrhage into the anterior chamber from under the flap is said to be controlled by previous instillation of solution of suprarenal extract. But even so, the difficulty in completely evacuating the lens-substance must at times be great. Vacher had one panophthalmitis in the above series.

PRELIMINARY IRIDECTOMY, some weeks before the extraction, used to be practised as a safeguard against infection of the eye. For such a purpose this tedious division of the operation has become quite unnecessary. The practice is now almost con-

fined to immature cataracts, in order that the opportunity may be taken to massage the lens, according to Förster, to *hasten the ripening* of the cataract.

In complicated cataract the extraction may have been preceded by an iridectomy, performed either for the reduction of tension in the eye, or for the making of an artificial pupil.

THE 'SIMPLE' OPERATION, WITHOUT IRIDECTOMY.

The time appears to be far distant when unanimity of opinion can be looked for on the subject of Iridectomy or No Iridectomy. The simple operation is decried mostly by those who have never taken to it, while others who have once given it a fair trial appear to be attracted by it more and more, without being able to justify their liking on very solid grounds.

The difference of opinion bears largely on the varying appreciation of the value of the round mobile pupil obtained, when all goes well, by the simple method. Most of the patients are too old to care much about the disfigurement of the coloboma of combined extraction, which may, indeed, be scarcely noticeable with a dark iris, or may be covered with the upper lid, if only the palpebral aperture be rather narrow. It has never been shown that the visual acuteness is at all impaired by the slight enlargement,* and sluggishness of the pupil produced by a narrow iridectomy. Thus, apart from liability to discomfort, retinal exhaustion, and, rarely, erythropsia on exposure to strong light, it is hard to define any particular disadvantages that are avoided in securing a normal pupil. The gain is too slight to justify any large risks or sacrifices. The penalties incurred by

* Indeed, where the vision is partly obscured by after-cataract, it has been held that the larger pupil is an advantage.

the simple method are seen in the complications met with. There is undoubtedly a much greater liability to prolapse of the iris, and cortex is more often left behind. The tendency to prolapse is a serious drawback, which is very insufficiently compensated for by a lowered risk of secondary glaucoma, in comparison with the combined operation. And were there no prospect of largely reducing the prolapse-rate of the average operator, the simple method would have few supporters. But that it can be so reduced is shown by such figures as Galezowski's—one prolapse in two hundred operations.* Thus, the question, essentially one of compromise, is gradually working itself out in the selection and management of cases.

Suitable Cases.—The cataract must be ripe, or its evacuation is likely to be incomplete. Hypersclerotic lenses are generally excluded, being too large to pass easily through the pupil. If the latter be small and rigid, as it occasionally is in old people, or if posterior synechiæ be present, an iridectomy must be made. The patient should be quiet, not prone to spasmodic closure of the eyelids, and there must be no cough. The conjunctiva should be fairly normal, so that if prolapse should occur the iris may not be exposed to the attack of pathogenic organisms. If the fellow-eye has been lost from any cause, many surgeons prefer to do an iridectomy. Finally, an operation begun as a simple extraction is often converted into a combined one, owing to difficulties encountered.

> At the Cowasjee Jehangir Hospital simple extractions have only been regularly performed for rather more than two years, and in this period their number has been but little over half

* See also our own experience at the Cowasjee Jehangir Hospital, given on p. 76.

that of the combined operations. The proportion would have been higher were it not that many unripe cataracts have been extracted, and the state of the conjunctiva was often unsatisfactory. I have never performed simple extraction in private work at patients' houses, because it would entail visiting on the following day with an assistant, prepared to excise prolapsed iris.

The Technique of the Operation is, of course, simpler and shorter than with iridectomy; but care must be taken not to over-stretch the sphincter of the pupil, nor to leave cortical matter hidden away behind the iris. A full-sized incision is more commonly required. And the spoon-pressure for the delivery of the lens is directly backwards, about the junction of the lower and middle fourths of the cornea, so as to tilt the upper edge of the lens well forward, to enlarge and occupy the pupil before it begins to move upwards. Backward pressure above the wound with the curette, held in the left hand, assists in drawing the iris back over the lens. Lenses with much soft cortex slip forward easily without injuring the iris; a little cortex is apt to remain behind the upper part of the iris, but, if ripe, is easily dislodged by a little pressure. Thin discoid lenses, on the other hand, though not likely to give trouble with cortex, very readily slip upwards instead of rotating at once forward, and then the sharp edge catches in the posterior surface of the iris, stretching the iris considerably and scraping off uveal pigment, before finally entering the pupil. It is then found that the sphincter muscle has lost its contractility, and the pupil, after replacement of the iris with the curette, remains more or less distorted, enlarged, and displaced upwards. Prolapse of iris is exceedingly likely to follow, unless (1) an iridectomy be now performed, or (2) eserine drops be used freely.

The iridectomy need not be complete; it is possibly better to simply buttonhole the iris, leaving the pupillary zone. It is not always easy of performance, however, as by this time the patient may have 'lost his nerve' and be unable to keep the eye still, and the pull of fixation forceps, now that the lens has gone, endangers the suspensory ligament. So the alternative, eserine instillation, may be preferable. Many surgeons consider it of little use in these cases. Certainly, a single instillation of a solution, 4 grains to the ounce, may be ineffective. If the closed lids are watched afterwards, the solution, diluted with tears, and perhaps aqueous humour, may at times be seen to collect and flow away at the outer canthus. But if three or four instillations are made at short intervals, the required effect is almost certainly secured. The fear of adding, however, to the injection of iris and ciliary body by the muscular spasm induced restricts the use of the drug as nearly as possible to its minimum effective amount. Whether a single instillation should be used as a routine measure in all simple operations is doubtful. The drops should, of course, be freshly prepared and sterile. And one must be ready to overcome their effect by the free use of atropine on the following day if iris and pupil are not quite clear.

Morgagnian cataracts are very suitable for simple extraction, provided the capsule is not opaque. The capsulotomy should consist in a transverse, instead of the ordinary vertical, slit; because if, owing to rapid collapse of the sac, only a small puncture should be made below, the nucleus may give a lot of trouble by slipping up within the loose capsule behind the iris. And the pressure with the spoon should be higher up than ordinary, very little below the middle of the cornea.

We always bandage up both eyes after simple extraction for one or two days, instead of leaving the unoperated eye open, as after the combined operation.

CAPSULOTOMY is replaced in the practice of some surgeons by partial *removal of anterior capsule* with special

forceps. The advantages claimed in respect to after-cataract are based both directly on the sure provision of a central space free from anterior capsule with its lens-cells, and also on the freer access of the aqueous humour to lens-remnants, likely in the ordinary operation to be shut off by union between the two layers of capsule. An examination, however, of the openings effected by free capsulotomy in ordinary elastic capsules, leaves one generally well satisfied with the result, as far as the anterior capsule itself is concerned. And, at least with irrigation of the anterior chamber, it is very rare for cortical remains to be left in a position to directly interfere with vision afterwards. Thus, to one who has had no experience of the use of the capsule-forceps, their advantage appears scarcely definite enough to compensate for the admitted slight risk of dislocating the lens in seizing and tearing away the capsule. It is more particularly in cases where the capsule is opaque and inelastic at the time of operation that simple division is likely to be insufficient. But here the use of capsule-forceps alone becomes dangerous, since the toughened capsule may prove more resistant than the surrounding zonule.

To avoid accidents, Terson* (père) recommends the combined use of cystotome and forceps, a small opening being first made with the former instrument. But, seeing that in many cases capsular opacity affects the posterior membrane as well as the anterior, it seems altogether more satisfactory first to make sure of the complete evacuation of lens-substance if possible; after which the full extent of the opacity can be seen, and measures taken accordingly.

Terson's forceps, as recently modified by Rochon-Duvigneaud, differ from ordinary iris-forceps in being slightly curved beyond the bend, corresponding with the posterior surface of the cornea; there are several teeth projecting downward near the point, to

* *Annales d'Oculistique*, October, 1900.

seize a large piece of capsule; and the blades of the instrument are open at the bend when closed at the point, in order that in simple extraction they may not grip the iris.

In direct contrast to the tearing away of anterior capsule is Knapp's and Gayet's *peripheral incision* 'in the upper part of the capsule parallel with the corneal section,' designed to keep lenticular *débris* enclosed, away from contact with the iris. The much greater frequency of after-cataracts requiring treatment condemns the practice.

Incision of the capsule with the point of the Graefe's knife, as it passes across the anterior chamber, is unsatisfactory for two reasons: (1) the opening may be insufficient, and (2) the manipulation of the blade of the knife may cause premature escape of aqueous. Dr. Powell reminds me of a third objection to puncture with the knife in operating on Morgagnian cataracts. The knife can no longer be seen after the puncture is made, owing to the 'milk' that pours into the anterior chamber.

THE EVACUATION OF CORTEX is by most operators accomplished only, so far as it is possible, by the 'lid-manœuvre.' While the upper lid is elevated, pressure with the finger-point is put upon the eyeball through the lower lid, with rotatory movements calculated to force up soft lens-substance from the periphery towards the wound. Care is taken to keep the margin of the lid from contact with the wound. It is not nearly so effective a measure as McKeown's *irrigation* of the anterior chamber and of the lens-sac, especially combined with spoon-pressure as already described. The preparation of the salt solution and the sterilizing of it and of the apparatus, when not done regularly for routine work, is a little troublesome; but this should scarcely count as a drawback. I have never known any accident from the introduction of the irrigator-nozzle into the anterior chamber—the introduction being invariably made by myself; but at times, in very unsteady eyes, the irrigation must perforce be imperfect, and accomplished by merely depressing the posterior lip of the wound on either side with the tip of the nozzle. Prolonged irrigation has appeared to me to have at times irritated the iris a little, and therefore I do not practise it more freely than necessary. But this impression is too feeble to weigh against the very decided advantage of the

fluid in getting rid of blood and of cortex, as well as in keeping the corneal surface moist during the operation.

Cortex left behind may tend to produce iritis, and, if in the pupillary area, must interfere with vision, at least for a time. Both of these troubles are considered later. For the rapid absorption of lens-*débris* the free access of aqueous humour is necessary—a point much insisted on by the advocates of the use of capsule-forceps. Whether absorption is directly aided and hastened by the administration of any drugs is somewhat doubtful. Blue pill and other preparations of mercury have had a certain repute, given for this purpose; but that they have acted chiefly by controlling iritis is very probable.

OVER-RIPE CATARACTS.—The troubles peculiar to these lenses depend mostly on opacity and toughness of the capsule—strictly speaking, not of the capsule proper, but of the results of the proliferation of the lens-cells lining the capsule. In Europe the generally accepted conservative practice is to perform ordinary combined extraction where possible, with certain additions. With this on the whole I certainly agree.

The opaque capsule presents difficulties in varying degree. The spotted capsule of Morgagnian cataracts can probably always be penetrated by a sharp cystotome, but a blunt point may simply catch in it and pull it about. The puncture of all Morgagnian lenses should be made rather sharply, otherwise (1) the soft bag of fluid is simply indented by the point of the cystotome—not penetrated; or (2) the sac, on being pricked, so quickly collapses that it recedes from the cystotome when only a small and insufficient opening has been made. In other cataracts, where there is a large central anterior opaque patch, the capsule may generally be scratched through below the patch and to one side of it, sufficiently for the easy exit of the lens. At the close of the operation something must be done for opaque capsule in the pupillary area. Occasionally, where it is only the posterior capsule that is

likely to interfere with vision, its puncture by the cystotome is sufficient (see p. 43). Opaque anterior capsule must be extracted with iris-forceps, sometimes alone, but more often bringing with it the whole of the posterior membrane also. Loss of vitreous is perhaps quite as likely to occur as when the lens is expressed within its capsule; but the loss is less likely to be large in amount, as the eye is now ready to be covered up, the conjunctival toilet having been already completed. Unless the patient be very unsteady, there appears to be no advantage in deferring this extraction of capsule; secondary operations for this purpose have earned a very evil repute.

There remain a number of cases where the cystotome, after reasonable attempts, fails to make an opening, and *extraction of the lens in its capsule* becomes imperative. With these lenses may be included extremely shrunken cataracts, consisting of little but opaque capsule, found chiefly in young people—often the remains of traumatic cataract—but at times also at an advanced age. Also it is a question whether in thoroughly quiet, reliable patients the removal of most Morgagnian cataracts by this method should not be attempted; if the lens should not come easily the attempt may be given up.

As regards the details of the procedure, there is in most cases nothing essentially different from ordinary extraction but the omission of the capsulotomy. It is advisable, however, that the conjunctival toilet should precede the delivery of the lens, which is accomplished by carefully graduated and slowly applied pressure with the tortoiseshell spoon in the regular way, with the upper lip of the wound depressed by the vectis, which is ready to be slipped in behind the lens if vitreous should protrude. If the patient be not quite collected and steady, the speculum should be replaced by Desmarres' retractor for the upper lid, with finger depression of the lower lid. But the change is only necessary where spasm of the orbicularis is feared; and this rarely happens without some warning, in the form of prelimi-

nary twitches of the lids and general uneasiness. The most easily expressed lenses are, in my experience, the Morgagnian; the adaptable soft sac of fluid at times fills the wound as soon as pressure is applied to the globe, and the exact moment of rupture of suspensory ligament is often not evident. This easy gradual delivery of the lens is especially frequent after an attempt at puncture of the capsule with the cystotome; the pull on tough capsule may have partly torn the zonule below.

It is surprising how often the lens can be thus expelled without being followed or accompanied by vitreous. Captain Henry Smith, I.M.S., reports* a series of 1,651 of these extractions at Jullundur in the Punjab, with only 8·2 per cent. of vitreous escape. He is the chief latter-day exponent of this operation,† which has long found favour in that province, remarkable in providing for a few surgeons an experience in cataract work far greater than is to be got anywhere else in the world. It has been practised largely by Mulroney at Amritsar, with a downward corneal section. And it has not been restricted to over-ripe cataracts only, but has formed the routine procedure for ripe and even unripe cataracts. With the latter, however, a second serious complication is frequently encountered; the capsule is liable to give way together with the zonule, with the result that cortex is left behind embedded in vitreous, and hence only imperfectly absorbed. That a surgeon should be able to obtain such results by this operation, as have been published by Smith, speaks volumes not only for the extraordinary dexterity of the operator, but equally so for the absolute confidence, self-control and docility exhibited by the patients. For the average operator and for the ordinary patient this operation must always remain chiefly one of necessity, and not of choice; and it will be combined with iridectomy, though this has been largely dispensed with in the Punjab. (When the iris is forced into the wound by the pressure of vitreous at the close of the operation, Smith evacuates some vitreous to allow of the reduction of the prolapse.)

There is undoubtedly a great fascination in the delicate and difficult manipulation required in this operation; and there is much satisfaction afterwards in being freed from the irritant

* *Indian Medical Gazette*, xxxvi. 220-225.

† An operation usually associated with the name of Pagenstecher in Europe.

effects of the minute particles of lens-matter left in contact with the iris in ordinary extraction. More important than this, there can be no slow deterioration of sight later from the formation of capsular opacity. But, on the other hand, contrary to what one would expect, our figures of the vision obtained with spherical lenses at the time of discharge from hospital show no superiority in eyes thus operated upon, over those in which the capsule has been left. Possibly there is greater average astigmatism from over-riding of the corneal flap, pressed a little forward by the vitreous. The chief drawback to the operation is that one cannot afford to ignore the possible evil consequences of loss of vitreous, recounted on p. 41.

The much *shrunken cataracts, mainly capsular*, occasionally met with, are best pulled out with forceps through a small section, either with or without iridectomy.

Most careful manipulation is demanded for *over-ripe Morgagnian cataracts, with all the fluid absorbed*—cataracts whose nature may not have been suspected until an iridectomy reveals a clear space above the small nucleus. The ordinary operation may be attempted; but the capsulotomy is difficult, and requires a sharp cystotome. The capsule, often quite transparent, is a loose mobile membrane with only the small nucleus to separate its two layers, and to guard the point of the cystotome from penetrating into the vitreous. The capsulotomy may fail, and yet the attempt may do good by pulling the remains of the lens up towards the wound, through which it may then possibly be expressed. Otherwise forceps may have to be introduced to seize both nucleus and capsule, if possible, or a scoop-extraction must be done; vitreous is almost certain to escape in quantity. In one case, with very little nucleus left, the patient saw fairly well with slightly dilated pupil. The vision was improved by displacement downwards of the remains of the lens with a needle. In somewhat similar cases a narrow iridectomy upwards, with or without displacement of capsule and lens-nucleus, might often secure very useful vision.

Among 960 extractions (linears excluded) performed at the Cowasjee Jehangir Hospital from January 1, 1901, to October 31, 1902, putting on one side three lenses squeezed out by the patient together with vitreous, and one scoop-extraction necessitated by escape of vitreous before the lens, there were only 32 extractions within the capsule deliberately undertaken, giving

6 vitreous losses; also 26 partial or complete removals of opaque capsule after delivery of the lens, giving 4 vitreous losses; 2 partial removals of capsule, together with puncture of the posterior capsule, without loss; and 10 simple punctures of posterior capsule, with one loss of vitreous.

THE OPEN TREATMENT OF WOUNDS.

Numerous objections have been urged against the pad and bandage: (1) They have a tendency in a few eyes to induce, or to maintain already existing, conjunctival injection and secretion; the heat of the pad and the stoppage of the blinking movements of the lids probably promote the development and retention of micro-organisms. (2) Frequent or constant inspection of the lids is rendered impracticable. (3) The bandage is liable to displacement by restlessness during sleep. (4) The pressure of the bandage, too tightly applied, may cause prolapse of iris. (5) The double bandage has been at times responsible for the development of mental depression or excitement in old people.

But it is obvious that these drawbacks mostly inculcate simply care in covering the eye, with limitation of the period, rather than the complete abandonment of dressings.

The completely open treatment of wounds by Hjort unnecessarily exposes the eye to injury,* especially during sleep. But the results obtained by simple protection† under a gauze shield show at least that the movements of the eyelids and the admission of (subdued ?) light are not in themselves in any way prejudicial in after-treatment. Observation tends to narrow the period of origin of most of the serious complications to the few hours immediately following operation; and the advantages of immobilization after this period appear to be appreciable only in the case of unreasoning and unintelligent patients. The exact lines of treatment found most suitable in different places and in different hospitals will probably vary with the conditions of nursing and with the class of patients treated. As compromises between the closed and open treatments may be mentioned the closure of the eyelids with court plaster, also the application of a pad for one day only.

* See Mohilla's results, *Centralblatt für practische Augenheilkunde*, December, 1899.

† Praun and Czermak, *ibid.*, March and May, 1898.

CHAPTER IV

AFTER-COMPLICATIONS

The Infective Processes—Striped Keratitis—Filamentous Keratitis—Exfoliation of Epithelium—Prolapse and Incarceration of the Iris—Expulsive Retro-Choroidal Hæmorrhage—Bleeding into the Anterior Chamber—Delayed Union—Filtration Œdema—Acute Dermatitis—Spastic Entropion—Mental Disturbance—After-Cataract—Secondary Glaucoma—Detachment of Retina—Transient Detachment of Choroid—Erythropsia—Indifferent and bad results.

THE INFECTIVE PROCESSES constitute by far the most important departures from the normal course of events after operation; they are the most frequent cause of partial or complete failure to restore sight, and often also of greater or less destruction of the essential tissues of the eye. Besides the actual entrance of pathogenic bacteria of varying degrees of virulence, factors influencing the grade and extent of inflammatory reaction are those affecting the vitality of the tissues. The danger of operating upon the eyes of patients in the later stages of diabetes or nephritis, or in a state of extreme anæmia (see p. 13), is well recognised; locally, the resistance to bacterial invasion may be lowered by excessive traumatism. The open door provided for the admission of infective material by prolapse of iris or of vitreous is alluded to on pp. 41, 49, and 78.

The most severe examples of the effects produced are

grouped as **Suppurations.** Starting either as corneal wound infections or as intra-ocular invasions, they culminate in *panophthalmitis*. The signs and symptoms are generally pronounced within twenty-four hours. There is severe pain, much inflammatory swelling of conjunctiva and eyelids (that of the margin of the upper lid being well marked), with semi-purulent conjunctival discharge lying about the borders of the lids. The edges of the wound may or may not be infiltrated. The corneal surface is often steamy, and the iris and pupil are covered with dirty lymph. In spite of all treatment the inflammatory conditions rapidly intensify. Fibrinous and purulent exudation accumulates in the anterior and posterior chambers, and in the vitreous, distending the eyeball and opening the wound; and, where the wound itself is directly invaded, suppurative destruction of the cornea spreads from it. These most severe cases are quite hopeless from the start; but there are others which begin rather less acutely, and hang for some days apparently in the balance. And there are destructive inflammations, rarely seen, which begin later, possibly several days after operation, in which the infection gains access to the eye in some way after the operation.

> In one of our suppurations everything went well, with easily dilated pupil and but little injection of the eye, until the case was transferred, five days after operation, to another ward where some patients were being treated for conjunctivitis, preparatory to cataract extraction. The next day the eye became inflamed, and in a few days had advanced to panophthalmitis.

The treatment of acute infection is as follows:

1. If the edges of the wound are infiltrated, the actual cautery freely applied may, it is said, possibly arrest the mischief.

Cases in which the infective material is confined to the wound must be very few in number; so localized invasion can scarcely happen with a conjunctival flap. In the one or two instances in which I had occasion to use the cautery thus, years ago, no benefit resulted.

2. The coverings of the eye are removed, and the conjunctival sac is frequently irrigated with perchloride lotion, 1 in 5,000 or stronger. Hot fomentations may be applied if they relieve pain.

3. In the more hopeful cases as much atropine is instilled as the patient can bear.

Six drops of watery solution, 4 grains to the ounce, are instilled at once, at intervals of five minutes, and three or four more drops are added in the evening. Most patients can bear nine instillations a day continuously, without constitutional symptoms beyond dry throat, if care be taken to prevent the solution from passing down the lachrymal passages. It is sufficient to tilt the patient's head to one side, to drain away the excess of the drop at the outer canthus, at the same time mopping up any moisture from the closed lids with damp lint. Opium may be given to control slight restlessness and sleeplessness. I have had no experience of the use of atropine ointment, or of the application of the solid sulphate.

4. Mercury is given freely by inunction, or by the mouth, or both. Five grains of calomel are administered at once, partly to act as a purgative. Possibly intramuscular injections should be used for the first few days, after Schirmer.* His experience proves the great value of the drug in infected wounds, both in controlling the inflammation and in preventing its sympathetic spread to the fellow-eye.

The cases that respond to treatment may end in—

1. Severe **Irido-Cyclitis,** leading in some instances to

* See v. Graefe's *Archiv für Ophthalmologie*, liii. 1.

shrinking and atrophy of the globe, but in others subsiding with the preservation of good vision; or

2. Rarely, **Localized Suppuration of the Cornea.** Occasionally a portion only of the wound may suppurate.

A third grade of intensity is seen in persistent inflammations, undoubtedly infective, commonly spoken of as **Iritis** simply, ending in closed pupil and coloboma from plastic exudation, but always with a prospect of restoration of fair sight by subsequent operation. The symptoms —pain, especially at night, ciliary injection and slight lid-swelling, with perhaps lacrymation and photophobia —may attract attention only some days after operation. Possibly, as a rough rule, the later the onset the milder the inflammation. In feeble, sickly persons there may be a quiet outpouring of lymph, with very mild or no symptoms. It is probable that focal illumination would show involvement of the iris in all of these cases the day after operation. Moreover, vigorous treatment with atropine and mercury, begun at once, would probably prove effective in controlling such inflammations. For since adopting this treatment as routine practice, maintained now through nearly 2,000 operations, the milder infections have practically ceased to be recognisable (see results on pp. 49 and 50), though formerly they were, as is usual, more common than the severer ones ending in atrophy or in suppuration. Of the many threatening appearances on the day after operation, which have resolved under treatment, it has been impossible to decide how far the signs of inflammation have represented infection, and how far simply reaction to traumatism, irritation from lens-*débris*, etc. That our exemption from the closed pupils of iritis is attributable largely to the after-treatment, and not simply to perfect

and complete protection of the wounds from infection, is shown by the rare occurrence after our operations of the graver forms of irido-cyclitis, ending in atrophy of the eyeball (the three cases of Group 2, p. 50)—infective evidences beyond the reach of treatment.

There are a few mild inflammations chiefly localized in the *ciliary body*, with tenderness on pressure and low tension. The prognosis is usually good.

An appreciable degree of **Non-Infective Iritis** is very common after our operations, for the most part very transient, and recognisable only by signs without symptoms. That it is due mainly to irritation from minute particles of lens-substance left behind is shown by its almost complete absence, both after extractions of the lens within its capsule,* and after most of the ordinary operations for Morgagnian cataract. Occasional additional sources of reaction are (1) a varying degree of traumatism, especially bruising of the iris in squeezing out the lens through too small a wound; (2) prolonged irrigation of the anterior chamber; and (3) reflex disturbance from an exceptional degree of surface irritation by the perchloride. Focal illumination on the day after operation shows us but few perfectly clear and active pupils, with bright iris. There are degrees of reaction culminating in a pupil partly occupied by, and in thickened iris partly hidden by, what looks like lymph more or less mixed with traces of blood and lens-*débris*. And it may take several days' free use of atropine, morning and evening, to obtain fair dilatation of the pupil. As already suggested, infection probably plays a part in most of the higher grades of exudative processes, but there is no

* See the remarks on this point by Henry Smith, who has had such an exceptional acquaintance with extraction within the capsule (*Indian Medical Gazette*, xxxvi. 221).

reason to suspect the same of the more common lower degrees. I have noticed an especially alarming amount of exudation, but very rapidly reabsorbed, in very anæmic patients occasionally operated upon. No pain is complained of, and the final result of the worst cases, after active treatment and a somewhat prolonged convalescence, is a varying amount of irregularly disposed pupillary membrane, adherent to iris at one or more points. By early minute inspection, and by rapid dilatation of the pupil in all cases where any trace of exudation is found, the dividing line is lost between the more trivial reactions and those which without treatment would develop into definite attacks of iritis, with symptoms and sequelæ. The formation of small posterior synechiæ merely at the raw edges of the coloboma, in combined extraction, or connecting the pupillary margin with the slit in the capsule, is not evidence of iritis. Other synechiæ may be left by imperfect absorption of blood-clot.

A large quantity of cortical matter may often be left behind, with no effect whatever on the iris,* if only the pupil be at once dilated. But if, perhaps owing to some additional cause of irritation, rapid dilatation of the pupil is not obtained, the lens-matter is then in contact with the iris, and may serve to keep up a definite chronic inflammation. In spite of treatment, the lens-remnants may gradually become hidden by a thin layer of lymph, adherent to the iris, which afterwards contracts, narrowing and occluding both coloboma and pupil, and drawing them up towards the site of the wound.

Venous congestion from constant coughing in chronic bronchitis, or from straining at micturition, in enlarged

* The immediate effect upon the iris of a large qauntity of unripe cortex appears scarcely greater than that of almost microscopic remnants of riper material.

prostate, may occasionally be largely responsible for a rather persistent mild iritis. Also *constitutional taints*, such as are capable sometimes of originating attacks of iritis apart from operation—*e.g.*, gout, rheumatism, diabetes, etc.—may be expected to give trouble at times.

It must not be forgotten that one effect of chronic iritis, whether infective or not, may be to produce secondary glaucoma, requiring operative treatment (see later).

What is known by the name STRIPED KERATITIS is seen the day after operation as parallel vertical gray lines in the upper half of the cornea, running down from the wound. The streaks have been shown to represent ridges on the posterior surface of the cornea, due to œdema, and are commonly the result of bruising of the cornea in squeezing out the lens through a rather small wound. Formerly it was very common at the Cowasjee Jehangir Hospital; now, with a larger section, it is seldom seen. It usually clears off within a week. Less often a diffuse cloud appears instead of the stripes.

In a case of delayed union of the wound, in which such a gray cloud appeared some days after operation, on the part of cornea corresponding with the pupil and coloboma, and evidently due to prolonged contact with lens-capsule (with perhaps traces of lens-*débris*), the opacity was permanent, and necessitated the making of an artificial pupil.

I have seen—though not in my own practice—permanen diffuse opacity of the cornea from the introduction, by mistake, of sublimate lotion into the anterior chamber.

FILAMENTOUS KERATITIS is given by Knapp as a complication seen in a small number of cases 'by the end of the second week.' I have seen it rarely after cataract extraction, but do not know wherein lies the connection.

I was once much concerned by the constant recurrence of this affection in an eye upon which I proposed to operate for

cataract. After much treatment I found that the daily application (for a few days) of 1 per cent. silver nitrate solution to the everted lids, the conjunctiva of which showed only some slight chronic thickening and injection, not only effected the rapid and certain disappearance of the corneal threads, but prevented their recurrence for ten days or more

EXFOLIATION OF EPITHELIUM from a portion of the corneal surface may be brought about by allowing the cornea to become dry during the operation, or by the excessive use of cocaine. It is of interest only as a possible way of entrance for infection into the eye, should the conjunctiva contain pathogenic organisms.

PROLAPSE AND INCARCERATION OF THE IRIS.

Prolapse complicates from 0·5 per cent. to 15 per cent. or more of simple extractions, the proportion varying with the operator, the nursing, the class of patients, etc.

At the Cowasjee Jehangir Hospital, before June, 1900, extraction was nearly always performed with iridectomy. Since then to the end of October, 1902, there have been 429 simple extractions, with 38 prolapses of iris—nearly 9 per cent. There have been over 50 of these operations since the last prolapse occurred. The experience of any one particular operator with the simple method frequently shows this marked improvement in later results.

It is generally found at the first dressing; but occasionally it may happen later,* or a mere incarceration or small prolapse of the first day may later enlarge. It usually occupies only a small portion of the wound, rarely the whole; it may include the whole breadth of the iris, or only its basal portion; it is nearly always partly or

* In one extraordinary case prolapse occurred after the patient's discharge from hospital; the eye at the time of discharge, thirty-eight days after operation, was tender and soft rom chronic cyclitis.

entirely uncovered by conjunctiva, except where a very complete conjunctival flap has been made. Though often predisposed to by damage of the sphincter of the pupil during the passage of the lens, it may yet occur in spite of an active pupil, from any sudden bursting open of the wound, through spasm of the orbicularis, or by increase of ocular tension from muscular effort or cough. After combined extraction incarceration of the iris in, and adhesion to, the wound largely takes the place of prolapse. Either of these conditions may result—at one or both angles of the wound—from imperfect replacement of the pillars of the coloboma, especially if much of the pupillary zone (with the sphincter muscle) of the iris has been cut away. At other times, after either the simple or combined operation, the iris may be carried into the wound by escaping vitreous.

The disadvantages and risks consequent on prolapse and incarceration of the iris are difficult to formulate exactly. The *corneal astigmatism* produced varies roughly with the size of the protrusion; it can be only partly corrected by cylindrical lenses. By a very extensive prolapse the upper half of the cornea may be bent slightly forwards, a fine transverse gray line on the back of the cornea marking the division between its two portions. Small protrusions tend to flatten down within a few months, largely reducing the abnormal corneal curvature. But the loop of iris remains, permanently weakening the sclero-corneal scar; a fistulous cicatrix is formed, with perhaps slightly reduced ocular tension. And should by chance the prolapse be subjunctival,* a sharply defined pale vesicular patch, of fair size, may develop over the

* This is uncommon after cataract extraction; I have seen much of subconjunctival prolapse, and its results, lately in operating for glaucoma.

remains of iris, showing the path of filtration of aqueous through the conjunctiva. A larger prolapse may not diminish in size at all, even though its neck, at the site of the sclero-corneal incision, may contract—as regards its internal, not its external, surface—so much that free communication between the cavities of prolapse and of eyeball may be lost.* The extruded iris gradually loses its pigment, becoming changed into more or less pervious fibrous tissue. The result is known as a *cystoid cicatrix*. The pupil is often considerably displaced upwards.

The most serious effect of prolapse is a permanent liability to *bacterial invasion* of the eye. With a large exposure of iris there is often at once some definite iritis, the enlarged and distorted pupil being from the first occupied by a thin layer of lymph. This is perhaps especially noticeable in Indian practice, where we have so many chronically inflamed conjunctivas. With a small prolapse, on the other hand, or with a prolapse of any size completely covered by conjunctival flap, the iris and pupil may remain perfectly clear throughout. With regard to later infection of the eye—either rapidly destructive, leading to panophthalmitis, or in lower-grade inflammations, more serious still from possible sympathetic involvement of the fellow-eye—some important practical problems bearing upon treatment have yet to be solved. Does the danger lie merely in the thin covering of the fistulous track, or in the direct connection of the uveal tract with the weak point? And does a conjunctival covering provide any permanent protection?

* On laying open the 'cyst' resulting from the prolapse, the anterior chamber does not at once empty itself. It is probable, however, that free filtration between the two cavities always persists.

The secondary glaucoma sometimes produced by narrowing of the filtration angle, by incarceration or adhesion of the iris about the wound, especially after combined extraction, is dealt with later.

Treatment.—Rarely, when from sudden pain the occurrence of prolapse has been suspected, its immediate replacement has been successful. The ordinary treatment of a protrusion seen not later than twenty-four hours after its formation consists in excision, enough iris being pulled out to free it completely from the wound. The small operation is apt to be a troublesome one, perhaps requiring chloroform, because the extruded iris is hyperæsthetic, and only rendered partially insensitive by cocaine, and fixation of the eye by forceps is permissible to but a limited extent. Should the prolapse be very extensive, or should the favourable time have passed, the chief aim of early interference—the separation of the iris from the wound—is no longer realizable, and treatment is commonly deferred until the eye has become free from injection, or given up altogether. Again, it seems scarcely desirable to interfere with the rare, small, entirely subconjunctival protrusions and incarcerations; though, if necessary, the conjunctival covering might be readily peeled off them for their excision. When a large prolapse is partly bare and partly covered by conjunctival flap, immediate excision of the uncovered portion is indicated.

The objects of later treatment include the removal of disfigurement and the reduction of corneal astigmatism. After the late removal of a small prolapse it is quite feasible, and it appears to me desirable, to cover the site with a strip of neighbouring conjunctiva. A band of undermined membrane may be drawn over it, and fixed by suture on one or both sides of the cornea. In the

treatment of a few prolapses too large to be covered by conjunctiva, fearing the connection of iris and uveal tract with the exposed, though altered, tissue, I have severed the adherent base of iris by a sclerotomy upwards, afterwards excising a portion of the prominence to produce flattening. Perhaps in such cases it would be better to wait for some months for partial closure of the neck of communication with the anterior chamber, and then to adopt Berry's treatment* for cystoid cicatrices. After freely laying open the 'cyst,' he cauterizes superficially the defective portion of the sclero-corneal cicatrix, which may then be expected generally to close firmly; the cyst wall is not removed, but remains as a covering to the cauterized tissue.

Eserine drops will not completely reduce a prolapse, though they may keep it from increasing in size. After excision of prolapse they may be used if the iris and pupil are quite clear; otherwise atropine may be required for accompanying iritis, and should be used unhesitatingly.

EXPULSIVE RETROCHOROIDAL HÆMORRHAGE.

This we have met with only twice in over 2,000 extractions, and one of the eyes thus destroyed was in a state of subacute glaucoma at the time (see p. 97). In the latter case the eyeball was found filled, and the wound distended, with clot the day after operation; in the other case, the hæmorrhage occurred during the operation, as is usual, forcing out the lens in its capsule, together with the vitreous.

In some cases there is trouble in stopping the bleeding, which is profuse. Immediate enucleation has been required; and suturing the wound, the erect posture, morphia injections, and a pressure bandage have been tried.

Though it affords a presumption of disease of bloodvessels, there may be no other indication of this. It has happened shortly after successful cataract extraction from the other eye

* *Ophthalmic Review*, xxi. 88.

of the same patient. Sometimes vomiting or exertion appear to have brought it on, possibly a few days after operation.

The question of operation on the second eye, after this accident, has been already considered (p. 14).

Once, in performing iridectomy for chronic glaucoma, we had a hæmorrhage large enough to expel the lens with a quantity of vitreous, and to afterwards distend the wound. But the patient a month later could count fingers at 9 inches; before operation he could count them at 2 feet. Such a case links the more profuse and uncontrollable hæmorrhages with the comparatively frequent small fundus hæmorrhages produced by operation in advanced glaucoma. Probably such a limited intra-ocular hæmorrhage was responsible for a large escape of vitreous at one of our cataract operations. The upper part of the cornea was slowly pressed forwards at the close of the operation; then followed sudden rupture of zonule and large loss of vitreous, but no blood appeared in the wound. A month afterwards the patient could count fingers at 2 feet with this eye; but later the vision fell to moving bodies, and the eyeball was shrinking.

BLEEDING INTO THE ANTERIOR CHAMBER a few days after operation formerly occurred rather frequently in our hospital practice, when the eyes were not protected by shields. It was mostly attributable to injury, by the patients wandering about or fingering their bandages, which also led to some slight inflammatory reaction. Unlike the blood left in the anterior chamber at the time of operation, which is often entirely absorbed, this later hæmorrhage more frequently leaves some permanent fibrinous deposit on the lens capsule, as a shrunken opaque band connected with the edge of the pupil. The less ready absorption of this hæmorrhage, occurring when the reaction to operation has fully developed, may be due to a slight admixture with inflammatory lymph.

I once saw it happen from sudden pressure by spasm of the eyelids, while the eye was being dressed, a few days after operation.

Rarely this hæmorrhage from injury may be large enough to extend into the vitreous, where it may interfere with vision for some time after complete absorption has taken place from the anterior chamber.

DELAYED UNION of the wound has been very rare at the Cowasjee Jehangir Hospital since a conjunctival flap has been invariably made. Formerly it was not at all rare for the anterior chamber to refill only after periods of several days up to two weeks (considerably longer delays having been recorded). Ordinarily the lips of the wound are glued together within a few hours sufficiently to retain aqueous.

In the process of healing of a corneal wound, the surface epithelium dips down often as far as one-fifth of the total thickness of the cornea.* In very rare cases it may grow down even into the anterior chamber.† Between the two limits there may be many cases with sufficient epithelial ingrowth to oppose a barrier to the proper cicatrization of the wound, and to maintain persistent leakage through it. But the exact nature of the failure of the early stages of union, which permits of this epithelial downgrowth, is often a matter of conjecture only, if cases of obvious incarceration of iris, vitreous, or capsule in the wound are excluded. It complicates simple perhaps as much as combined extraction.‡

It is curious that imperfect union rarely leads to evil consequences. Prolapse of iris, infective inflammation, corneal opacity (see p. 75), and anterior synechiæ are all possible, but uncommon, results.

* Hocquard, *Annales d'Oculistique*, cxxvi. 342.

† Meller, v. Graefe's *Archiv*, lii. 3, epitomized in *Ophthalmic Review* of November, 1901.

‡ Norris and Oliver's System, iv. 398.

Treatment.—Nothing has ever been required in our cases beyond continual bandaging. Light stimulation of the wound with nitrate of silver or iodine solution and iridectomy are means which have been successfully employed in obstinate cases.

FILTRATION ŒDEMA of the ocular conjunctiva, from subconjunctival leakage through the wound, is to be expected as an occasional unimportant transient effect from the use of a wide conjunctival flap. Through the semi-transparent membrane the lips of the sclero-corneal wound may perhaps be seen to be slightly separated. It looks rather alarming until the absence of signs of grave complication are noted. It is paler than inflammatory œdema, and is confined to the ocular membrane, and tends to gravitate to the lowest part of the conjunctiva.

ACUTE DERMATITIS of the eyelids and neighbouring skin may be occasioned rarely by overfree use of perchloride, probably aided by the subsequent bandaging. It probably indicates a special idiosyncrasy. In the few cases we have seen (some years ago) there was no particularly remarkable reaction of the conjunctiva. The sharply-defined, reddened area of skin had an erysipelatous appearance. In one patient numerous bullæ formed, and the discharge from them caused an extension backwards of the inflammation over the scalp, and, entering the conjunctiva, produced an hypopion, evidently by infection through the imperfectly-healed wound. The final result was, however, quite satisfactory.

SPASTIC ENTROPION of the lower lid in old people, promoted by the bandage, may very rarely necessitate an early removal of the bandage, with, perhaps, the application of strapping to the lower lid for its relief.

Of MENTAL DISTURBANCE in old people, due to the covering of both eyes, or to confinement in dark rooms, I have had no experience (unless possibly in one patient, who without cause left hospital one night, and was found with his skull fractured by a fall from a bridge).

Delirium tremens also, after operation, does not touch our

work in India. The only troubles of this sort that we have had were a few cases of delirium from atropine poisoning.

FLATULENT DISTENSION of the abdomen is very commonly found here, especially in private patients, the day after the operation. The patient has generally passed a sleepless night, and often has pain in his loins. These troubles are due to the patient having lain on his back, afraid of the smallest movement, thinking that his eyes might be injured thereby.

AFTER-CATARACT.

Membranous opacity after cataract extraction interferes with vision to an appreciable degree in perhaps the majority of cases, either immediately after operation, or by slow development even many years later. It results from the following, either singly or together: (1) Abnormal proliferation of lens-cells; (2) imperfect absorption of cortical remains, shut off from the aqueous by union of the two layers of capsule; or (3) the deposit of lymph or blood-clot on the capsule, associated with one or more posterior synechiæ. The first variety of opacity may, of course, date from before operation, particularly affecting the anterior capsule, but also at times the posterior capsule. (It is often impossible, a little time after operation, to distinguish between the anterior and posterior layers.) The visual defect may be due as much to inelasticity of the capsule as to its opacity; for sometimes, especially after the extraction of Morgagnian cataract, the edges of the slit made in the anterior capsule may be seen to have quite come together again, instead of providing the desired central opening. As regards the later development of capsular opacity, it is uncertain what influence the drag of posterior synechiæ, or the irritation of retained cortex, may have in stimulating the proliferation of the lens-cells. In some cases,

after a time the transparent capsule by uneven contraction becomes drawn into fine parallel folds, and this may largely account for depreciation of sight.

It is remarkable how much of the third form of opacity may be present without marked effect on the visual acuteness, portions of the visual field only being blotted out. From these cases with good central vision it is but a step to entire covering (occlusion) of the pupil, reducing sight to moving bodies only; and, again, another step from this onwards to pin-point contraction of pupil and coloboma and their drawing up to the wound.

The exact degree of defect that calls for interference varies much with the occupation and desires of the patient. Before undertaking any treatment, a careful examination of the membrane by focal light and with the ophthalmoscope should be made, the pupil being dilated with atropine, where possible.

The *treatment* of after-cataract is a matter of the greatest importance in Europe; less so in India, where many of the patients are satisfied with only fair vision. The most diverse opinions have been held on the subject. Some well-known authorities have had cause to reject all subsequent interference as more dangerous than cataract extraction; whereas others, among whom Knapp stands out with the best results, look upon secondary capsulotomy as practically free from risk, and the normal complement of perhaps the majority of cataract operations.

After simple cutting or tearing with needles, two sets of complications have been met with—inflammatory and glaucomatous. The former have been especially frequent and disastrous after operations with scissors or forceps through small corneal wounds. They appear to

spring from either of two sources*—(1) the pull on previously inflamed iris and ciliary body, and (2) the entry of fresh infective material through vitreous lying in the needle-puncture or in the corneal incision. The re-awakening of old dormant mischief appears responsible for some, at least, of the low types of inflammation set up; while fresh infection more reasonably accounts for occasional rapid suppurative processes. The gradual spread of opacity backwards has been observed in a tag of vitreous caught in the wound. These considerations supply the safeguards that have been found effective and necessary in the most successful work. The secret of Knapp's success seems to lie in the use of perfect instruments, and in gentleness and simplicity of procedure. The even stem of his cutting needle just fills the corneal opening made by the blade at its end; this opening closes at once on withdrawal of the needle, usually with retention of aqueous and vitreous. The round stem allows of rotation of the narrow blade, to make a crucial or T-shaped incision, which is located by preference in the thinnest parts of the central capsule, to avoid unnecessary drag upon its attachments. Stress is laid upon the cutting—not tearing—of the membrane by the knife-edge, which must be as sharp as possible. Unfortunately, these delicate instruments do not wear well. After once or twice re-setting, the worn blade no longer equals the shaft in bulk. The latter has then to force an entrance, and the opening in the cornea thus made remains patent, on withdrawal of the needle, long enough for aqueous to escape and for vitreous to follow. It is obvious, however, that this should be of little con-

* The disturbance of vitreous by unnecessarily deep needle-punctures has been thought to have given rise to vitreous opacities; but there is little evidence to support this.

sequence, if the same care has been taken to clear the conjunctiva of bacteria, as is done in our cataract extractions. A 'second line of defence' may be secured by making the puncture, not through the cornea, but through scleral tissue close to the cornea, and covered by conjunctiva, as can easily be managed by sliding the loose ocular membrane caught on the point of the needle. But even so, it is doubtless well to avoid producing incarceration and prolapse of the vitreous, if possible. For this purpose, working at a distance from the best instrument-makers, it seems preferable to make use of instruments always at hand, and more easily sharpened —our old narrow worn Graefe's knives. There is ample room for their entry into the anterior chamber through the sclerotic close to the corneal margin, and there is no question of disproportion between the opening made and the blade filling it, as above. The disadvantage of this narrow knife is that it can be used only for a single cut; it cannot be rotated while in the wound, like the cutting needle. The single cut in the capsule must be long, to enable it to gape widely, from the tension of the membrane and by the protrusion of vitreous into it. To obtain a wide opening the incision should be through the densest portions of membrane, the direction of the cut being varied accordingly. To avoid unnecessary drag on the ciliary body, the incision is made by sawing movements, taking care to use the back of the blade for leverage, in order not to enlarge at the same time the scleral puncture. Following da Gama Pinto,* I have practised this simple division on all varieties of after-cataract, except the denser capsular opacities of over-ripe cataracts, which have been always extracted with the lens; and I have seldom found any further proceeding

* *Annales d'Oculistique*, cxvii. 22-40.

necessary. But, using very narrow knives, there has been no need to puncture behind the ciliary body and through the vitreous, as he has done. Simple non-inflammatory membranes, instead of being cut as intended, have occasionally been torn by the pressure of the knife, perhaps towards the periphery; and the displacement of the torn capsule has in a few cases been insufficient. In a few other cases, the edges of the cut in inelastic capsule—especially of Morgagnian cataracts—have come together again, necessitating the subsequent widening of the opening by the insertion and separation of the points of two Bowman's needles. These are introduced, like the knife, subconjunctivally through the sclerotic. In a few cases where the tissue was expected to prove thicker and tougher than usual, the two needles were used to pierce and tear the membrane, without any previous attempt at cutting. The results of single division are possibly more certain in slightly complicated opacities, with one or two posterior synechiæ to serve in pulling open the incision. For occluded pupils, the simultaneous division of iris, capsule and remains of inflammatory tissue has generally provided a sufficiently wide gap; but at times a second small incision, to make the whole T-shaped, has been added after an interval. Especially in these old inflammatory cases, there has at times followed some slight prolonged injection of the eye, with low tension; and in one or two instances of simple opacity a glaucomatous attack was provoked. But, since giving up puncture of the cornea—by which I once caused panophthalmitis—I can remember no serious and definite ill-results. My cases, however, have not been very numerous, nor have they been sufficiently well recorded to be collected as evidence.

I have not seen Stilling's harpoon-needles, designed for pulling apart the margins of a capsular opening.

For *iridotomy* and capsulotomy, to obtain openings in the matted tissues left by iritis, section with de Wecker's scissors, introduced through a small peripheral corneal incision, is in great favour. Diverging cuts may readily be made, separated by a tongue of tissue, which will retract, and thus effect a good opening. Pull on the ciliary body is, to some extent, avoided; but it is doubtful whether the necessary perforation of iris and membrane by the corneal lance, or by pointed scissor-blade, does not entail as heavy pressure as the long cut with the much sharper narrow knife. The liability of the corneal incision to be occupied by vitreous is the drawback to the operation. The risks, however, from this exposure of vitreous might be materially lessened by making the wound sclero-corneal and subconjunctival. By Levinsohn's scissors, with blades sharpened on both edges, the cornea, or sclerotic and cornea, can be pierced directly; but the advantage of this is not very apparent.

Knapp's *irido-cystectomy*, or excision of iris and pupillary membrane, pulled out of a small wound with a blunt hook, has little to recommend it.

It is difficult to realize why *extraction*, by forceps, of after-cataract free from adhesion to iris—which has in some hands given very bad results—should be any more dangerous than the removal of opaque capsule at the close of the operation for extraction of the lens. Antiseptic precautions and a large conjunctival flap should be sufficient to guarantee safety from infection. I have extracted in this way, without accident, a few very over-ripe and shrunken cataracts, almost entirely capsular, but only as a primary operation.

The glaucomatous complications of needle operations are referred to later.

The most suitable time for interference with after-cataract varies with the nature of the opacity. For occluded pupil, a delay of some months after the disappearance of ciliary injection is perhaps advisable, lest the old inflammation be revived; but for the results of lens-cell activity, the sooner treatment is undertaken,

after the eye is free from injection, the better, since delay will only add to the toughness of the membrane.

SECONDARY GLAUCOMA has been said to follow about 1 per cent. of 'combined' extractions, but is less often seen after 'simple' operations. In India one has very little experience of it; its apparent rarity is probably an illustration of the reluctance of the patients to come for treatment a second time. The larger proportion complicating the combined operation represents the greater liability to incarceration or adhesion* of iris and capsule in and about the wound, which take the place of the prolapses of simple extraction. The obliteration of part of the filtration angle, with narrowing of the remainder, by the forward displacement of the iris, especially with a purely corneal wound, appears sufficient in some eyes to set up glaucoma. In other eyes the high tension is secondary to chronic iritis, which may also serve to draw forward the iris and capsule to the wound by the contraction of inflammatory lymph. The relative parts played by this narrowing of the anterior chamber, and by the accumulation of albuminous exudation, probably vary in individual cases. A few inflammatory cases are the only ones that I can remember seeing after our own operations.† In a recent case the high tension was brought about by rapid 'exclusion of pupil,' due to the irritation of some creamy, broken-down, cortical matter left behind the iris. It came on two days

* At times impossible to avoid in restless patients, but otherwise preventible by proper replacement of iris and capsule at the close of the operation.

† Two patients operated upon in 1896 and one in 1897 came back later with glaucoma secondary to chronic iritis. But I believe no other similar cases have been seen of late years. This exemption is attributable to better management in preventing and controlling iritis.

after* the operation, which was a 'simple' extraction of a partly Morgagnian cataract. In some slight chronic rises of tension the cause may not be very apparent. The glaucoma may be evident as soon as firm healing of the wound has taken place, or it may be found to be the cause of slow deterioration of sight long afterwards.

A quite sudden rise of tension appears to be excited more frequently by needlings of after-cataract than by cataract extractions, and is not always readily explained. It may be the result of slight imflammatory reaction from the pull on the ciliary body, sufficient to bring into prominence a tendency to glaucoma already there, as a legacy from the extraction operation. And perhaps at times the setting free into the anterior chamber of some imprisoned cortical *débris* may act as it is liable to do in the discission of soft cataract.

> At other times neither of these accepted explanations will suffice. For instance, I lately provoked an attack of glaucoma in the eye of a boy by needling a capsular cataract, with very little imprisoned lens-substance, left after simple discission several years earlier. The iris was slightly atropic from former inflammation, but there was no shallowing of the anterior chamber.

The *treatment* of this complication must vary according to its mode of production. The operative procedure indicated may be simple division of pupillary membrane, or some form of sclerotomy, or iridectomy. Slight cases arising from needlings often give way to eserine. On the other hand, *plus* tension associated with distinct iritis demands relief by operation, together with the treatment of the inflammation by atropine.

* This very early onset of glaucoma is more common after simple extraction than combined (see Norris and Oliver's 'System,' iv. 392).

DETACHMENT OF RETINA, destroying vision, is the complication most feared after considerable loss of vitreous, though some eyes retain good vision permanently after very large losses. It may happen while the patient is in hospital, or after a considerable interval. A small escape of vitreous has probably no influence in this direction in eyes sound except for the cataract. But in highly myopic eyes, the evidence being accumulated with regard to removal of the transparent lens suggests that the operative procedures in themselves have a slight tendency to produce detachment; the vitreous in these cases is often a little disturbed by the needling of posterior capsule.

Complete separation of the retina is one of the consequences of protracted irido-cyclitis, but in itself is of little or no consequence, as the vision is otherwise destroyed.

Of TRANSIENT DETACHMENT OF CHOROID, seen after cataract extraction, I have no personal knowledge. Specially studied by Fuchs,* it appears rather a pathological curiosity than an important clinical fact, inasmuch as it usually happens at a time—two to eight days after operation—when eyes are rarely examined ophthalmoscopically, and passes away before the time comes for testing sight, and never permanently affects the vision. It seems to be due to the penetration of aqueous into the suprachoroidal space through a small tear at the attachment of the ciliary body, and is marked clinically by failure of the anterior chamber to properly refill, or by its emptying after once refilling.

ERYTHROPSIA—red vision—has been complained of extremely rarely by any of our patients, possibly because they are warned to wear dark glasses after discharge from hospital. For a good account of it see Norris and Oliver's 'System,' iv. 394.

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* Von Graefe's *Archiv;* epitomized in the *Ophthalmic Review*, xxi. 154.

INDIFFERENT AND BAD RESULTS, on discharge from hospital, among 885 extractions, from February 1, 1901, to September 30, 1902, the greater part of the period under review on p. 50; collected to give some idea of the complications before and after operation that have interfered with vision:

1, V = nil. Patient 22 years; over-ripe cataract, possibly congenital. Absence of vision unaccounted for.*

1, V = light only. Acute traumatic glaucomatous irido-cyclitis at the time of operation.

10, V = moving bodies only—

- 2, much cortex left.
- 2, much cortex left, with glaucoma; iritis afterwards in one.
- 1, lens lost in vitreous.
- 1, disease of vitreous, soft eyeball before operation.
- 1, nystagmus, congenital cataract.
- 1, old secondary glaucoma, posterior synechiæ.
- 1, probable detachment of retina after vitreous loss.
- 1, operation for relief of pain only in very advanced glaucoma.

57, V = fingers counted at distances below 10 feet with the help of a spherical lens—

- 4, leucomata.
- 6, diffuse corneal opacity, remains of pannus.
- 1, large prolapse of iris.
- 1, large prolapse of vitreous.
- 9, cortex left.
- 2, after-cataract, blood-remains.
- 7, sequelæ of iritis before operation (vitreous opacity, etc.).
- 1, congenital coloboma.
- 3, vitreous opacity.
- 2, large vitreous loss.
- 6, glaucoma at the time of operation or formerly.

* The cases unaccounted for are explained thus: Though I saw them all before discharge, the vision was not tested till after I had given permission for their discharge, and hence the opportunity for investigating the cause of visual defect was lost.

1, congenital cataract probably.
2, squint.
1, albuminuria (fundus not examined).*
10, unaccounted for,* some of them probably due to astigmatism from the operation.

—

69 (total).

P.S.—This collection of poor results, with what has gone before, may take the place of statistics of total results worked into groups of 'good,' 'fair,' etc. Such statistics vary so much with individual interpretations of the classification as to serve no very obviously useful purpose.

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* See footnote on preceding page.

CHAPTER V

COMPLICATED AND SOFT CATARACTS

Cataract with Glaucoma—Cataracts secondary to Irido-Cyclitis—Extraction in High Myopia—Dislocated Lenses—The Extraction of Soft Cataract.

CATARACT WITH GLAUCOMA.

THE shallow anterior chamber commonly seen with the swollen liquefying form of cataract has been repeatedly referred to in the foregoing pages. The question strikes one: Does not this shallowing in old people ever give rise to glaucoma? I am convinced that it does.

In Bombay the triple association is frequently seen of recent congestive glaucoma with swollen cataract and very shallow anterior chamber. And the connection is emphasized by the following considerations: (1) These cases include the majority* of the subacute glaucomas seen, the great bulk of primary glaucoma in India being distinctly chronic, simple or congestive. (2) Other forms of cataract associated with *recent* attacks of congestive glaucoma are decidedly uncommon. (3) The shallowing of the anterior chamber is frequently extreme. Where comparison can be made with the chamber of a fellow-

* I have no figures giving the proportion of these cases compared with ordinary subacute glaucomas without cataract. My impression is that the former are at least twice as numerous as the latter in Bombay.

eye as yet uninfluenced by glaucoma, cataract, or cataract extraction, that of the glaucomatous eye is generally distinctly the shallower of the two. In a few cases the difference in depth is inappreciable;* but it must be borne in mind that the dilated pupil and altered iris of the affected eye prevent very exact comparison between the two eyes. This difference in anterior chambers, though not quite exclusively the property of these cataractous glaucomas, is sufficiently so to remain their chief distinctive feature. During the period of collection of the statistics given below it was found but five times in glaucomatous eyes without cataract, or with only incipient cataract. In ordinary congestive glaucoma the relation is commonly reversed; the chamber of the affected eye is less shallow than that of the unaffected —but predisposed—eye. (See Czermak, quoted in the *Ophthalmic Review*, xvi. 199.)

> It is by no means contended that the cataract formation always takes a very large place in the etiology of these high tensions. For the large majority of such swollen cataracts pass through their whole course without altering the tension of the eye at all. And of the thirty-three of these cataracts associated with recent congestive glaucoma, of which I have notes, five had advanced to the Morgagnian stage, though in four out of these five cases the glaucoma was by no means advanced. In two of them there was still some pupillary reaction obtainable; in one of these two and in another case the tension gave way completely to eserine before operation; and in the fourth case the attacks of high tension had been intermittent.
>
> Among other factors in etiology may be noted the predis-

* I have rarely seen congestive glaucoma together with Morgagnian cataract and an anterior chamber *deeper* than that of the unaffected eye; but in only one case was the glaucoma apparently [illegible]ent origin. In this case it must be assumed that the cataract [illegible]part in the production of the high tension.

position to glaucoma frequently shown by the (less) shallow chamber of the unaffected fellow-eye. And at times there is a definite exciting cause for the onset of high tension; in two of our cases it was operation upon the other eye, and in at least one other case it was probably the use of a mydriatic.

During the two and a half years over which the above thirty-three cases have been spread, six similar cataracts were seen with only a low degree of plus tension, in eyes quite or nearly free from injection. And ten others were found without high tension, but with some enlargement and sluggishness of pupil. In six of these cases the abnormality of pupil was very slight, and might easily have escaped notice; in two of the remaining three, there was contraction of the field of projection also, evidently from high tension that had passed off for the time.

Thus the *prima-facie* presumption in favour of this etiological relation between swollen cataract and glaucoma is supported by a considerable body of evidence, collected in a comparatively short time. It is further borne out in treatment. Indeed, it is the consideration of *treatment* that supplies the strongest warrant for the separation of these glaucomas into a special group. In two of the first few cases treatment of the glaucoma was attempted on orthodox lines, but both gave a lot of trouble.

In one case the anterior chamber failed entirely to refill after a perfect iridectomy with conjunctival flap. Plus tension returning after three weeks necessitated cataract extraction, assisted by preliminary posterior scleral puncture. The incision had to be made mostly with scissors, owing to the absence of an anterior chamber. Some cortex was left obscuring vision; and three weeks later still, *plus* tension was again evident. After another posterior scleral puncture the patient disappeared, tired of treatment.

In the other case the tension was finally reduced, and useful sight restored by a 'sclerotomy with conjunctival infolding,' after the failure successively of (1) eserine with small sclerotomies, (2) iridectomy, (3) cataract extraction, and (4) sclerotomy with division of adherent root of iris.

In the light of these cases it was then recognised that, if the cataract were admitted as a factor in the causation of the glaucoma, the correct treatment of the later necessitated the prompt removal of the lens. This was done, with combined iridectomy, in twenty-two of the thirty-three cases of congestive glaucoma, resulting in the recovery of useful vision in all but three eyes. In one of these three eyes the wound was found next day distended by a large clot from intra-ocular hæmorrhage. In the second, there was only perception of light—no projection, and operation was for the relief of pain, without definite prospect of any restoration of sight. In the third case a temporarily poor result—fingers at 1 foot—was attributable to cortex left behind and to the remains of blood-clot. The field of projection was very much contracted in some of the eyes operated upon. No patient has come back with return of high tension; and in the few eyes seen later, at various intervals, the vision had still further improved.

> This treatment appears at first sight very bold. I have a great fear of large incisions in eyes affected with advanced primary chronic glaucoma. But in the eyes now considered, where the high tension is of recent onset, and where, moreover, it is partly 'secondary' in origin, changes in the walls of the bloodvessels may not be very marked. In five of the eyes thus treated the tension was fully reduced by eserine before operation, and in some of the others the congestion was only moderate, so that chloroform was seldom needed.* In three eyes (chloroform cases) the knife had to be thrust through iris and lens in making the incision, owing to extreme shallowing

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* The patients were warned that there would be pain, and the operations were performed with particular care and gentleness. Possibly in European practice chloroform might have been required oftener. In operating upon an eye free from tenderness on pressure, there should be no more pain than a person of average self-control can bear without flinching.

of anterior chamber. In three other eyes (tension reduced by eserine) opaque lens capsule was extracted—with the lens intact in two cases, and after the lens in the third case—without loss of vitreous; and in another eye, the lens in its capsule was forced out by spasm of the lids, with escape of vitreous.

In the remaining nine cases out of the thirty-three, little or no treatment was adopted, either owing to the patient's objection to operation or to poor prospects as regards vision, there being perception only of light, without projection.

A causal relation between cataract and glaucoma exactly the reverse of the above is frequently seen. Glaucoma in temperate climates appears seldom to give rise to cataract until it has become absolute. But in India cataract, as a result of primary glaucoma, frequently comes on earlier, reducing what would be otherwise useful vision. It is not, however, sufficiently ripe to permit of extraction at the time when operation is demanded for the high tension. It may be expected to go on developing slowly after the glaucoma has been relieved, and may need extraction months or years later.

The chance coincidence of cataract and early glaucoma in the same eye is seen at times. The absence of etiological relation between the two may be assumed with the forms of cataract that lead to no shallowing of the anterior chamber. Incipient cataract and incipient glaucoma are seldom seen together, probably because most lenses in the early stage of cataract formation are reduced in volume. I have notes of a few cases of glaucoma developing together with hypersclerosis of the lens; it is doubtful if these lenses are smaller than normal. Supposing operation for the reduction of tension has failed, one may feel tempted to extract an unripe cataract to get rid both of the tension and opacity. The only two cases in which I thus operated turned out badly (one of them is given in detail on p. 51).

CATARACTS SECONDARY TO IRIDO-CYCLITIS, with occlusion of pupil (*cataracta accreta*), and in some cases of adherent leucoma or staphyloma, often give good results if the eye be not softened,* and if the projection of light be fair. The cataract may not be detected until an artificial pupil has been made; and after the lens-extraction there may possibly be a third operation required for membranous opacity. This is rather tedious. If it seems very probable that ripe cataract is present—*e.g.*, in old dense occlusion,† or if the lens can be partly seen through thin pupillary membrane — the operation for extraction may be combined with an iridectomy upwards, and in some cases opaque capsule may be removed at the same time. It is surprising how readily the capsule comes away at times from its old adhesions to iris, whose tissue may now be more or less atrophied and friable. Proceeding thus in the one operation, but step by step, I have had unexpectedly good results; the number of cases has, however, been small as yet. In Wenzel's method the knife, while making the corneal incision, passes through iris and lens-capsule, a portion of these matted membranes being afterwards cut away with scissors. This mode of operating may be forced on one by a very shallow chamber, in leucomatous and staphylomatous cases, and is perhaps preferable when there is much matting together of iris and lens-capsule

* With adherent leucoma or staphyloma, operation of some kind may be demanded for secondary glaucoma.

† It is, as a rule, scarcely too much to assume that in old dense occlusion of pupil ripe cataract is present, and that it is fit for extraction if the tension of the eye be fair and the projection of light good. But in one patient lately, aged thirty-two years, acting on this assumption, I made a large incision unnecessarily, and lost some vitreous. The lens had become absorbed. A simple free incision of the remains of iris, capsule, and inflammatory tissue would have been sufficient.

('total posterior synechia'). Personally, however, I have only practised such an incision in two glaucomatous cases, not secondary to irido-cyclitis—already mentioned—cases quite different from those now considered.

EXTRACTION IN HIGH MYOPIA.

This small book does not include within its scope the consideration of the treatment of high myopia by removal of the transparent lens, but merely touches upon it lightly in the operative measures undertaken. The treatment varies from repeated discissions to the (incomplete) extraction of the unaltered clear lens. But the usual practice is 'linear extraction' of the lens rendered opaque by discission. This, as far as young patients are concerned, is dealt with later together with other forms of soft cataract. The only special feature is the danger of detachment of the retina, a risk already present in some of these eyes, but possibly increased to a slight extent by operation, even apart from escape of vitreous. In older persons, cataract formation after needling has to be very cautiously watched for the probable onset of high tension; preliminary iridectomy has been sometimes done with a view to lessen this liability. And the older the patient, the greater the danger, probably, of retinal detachment. And, owing to the presence of a hard nucleus, the incision for extraction has to be large, as for ordinary cataract extraction.

Incipient cataract developing spontaneously in a highly myopic eye is classed as secondary if there be disease of the vitreous; it may be of very slow formation, and remain for long limited to the posterior surface of the lens. When too advanced to allow the fundus to be

seen, a limitation of the field of projection would suggest detachment of retina, especially if the tension of the eye were low, and would contra-indicate operation.

In any operation in high myopia particular care is taken to avoid loss of vitreous.

DISLOCATED LENSES.

The ill effects of 'couching' and 'reclination' of cataracts by *vaids* and *hakims* are seen all over India. I have extracted one or two lenses which had returned to their normal position after such operation, but have not cared to interfere otherwise.* Lenses dislocated spontaneously or traumatically into the anterior chamber are met with everywhere. In India such cases are frequently brought for the relief of pain only, after the lens has become opaque, and after the possibility of restoration of sight has been lost through secondary glaucoma. In extracting a lens from the anterior chamber, if the incision be carefully made with a very narrow knife, there is usually no need for special measures to prevent the lens slipping back into the vitreous, such as the fixing of the lens with a needle, or operation with patient in the semi-prone position. If it has lain long in its abnormal position, it may have become firmly fixed to the cornea.

> In attempting to remove a lens partially luxated downwards in the posterior chamber, I found it so firmly adherent below that only partial removal with the scoop was possible. A good deal of cortex was left and much vitreous lost, and the resulting vision was worse than before operation.

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* Captain Henry Smith, I.M.S., reports sixty-nine extractions of couched lenses (*Indian Medical Gazette*, xxxvi. 224).

THE EXTRACTION OF SOFT CATARACT.

Operation for the removal of soft cataract—*i.e.*, opacity in lenses which have not yet developed hard nuclei—is mostly performed on lenses which have been rendered more or less completely cataractous by discission or needling, either for partial cataract—generally lamellar—or for the treatment of high myopia. In other cases operation is for traumatic cataract, from accidental wound or rupture of lens-capsule; or again, for idiopathic general cataract in young persons.

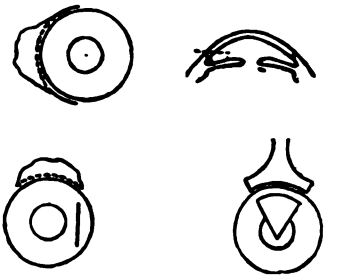
> Traumatic cataract is nearly always met with at an age when the lens is still fairly soft. There is often inflammation, infective or otherwise, which may render delay in operative interference advisable, unless pressure from the swollen lens appears to be keeping up the inflammation.

Sometimes extraction is an expeditious alternative to the very tedious, but on the whole safer, absorption of lens-matter under repeated needlings, or it may be compulsory for the removal of inflammatory or glaucomatous complication.* In the former case it is not done until the cataract is ripe, and therefore easily removable; in the latter case it may be only a very partial operation, much sticky unripe lens-matter being unavoidably left behind.

The usual operation is known as **linear extraction** or 'curette evacuation.' A straight linear wound, 5 millimetres long, is made in the cornea with a triangular keratome, rather nearer the margin than the centre of the cornea. If the lens-capsule has not previously been

* These complications are especially likely to follow the too free admission of aqueous to *transparent* lens-matter, which rapidly swells as it becomes opaque. On the other hand, in over-ripe cataracts sudden high tension may result from a quantity of albuminous milky fluid being thrown into the anterior chamber.

opened, it may be done now with the point of the keratome. If the cataract is fully ripe and soft, depression of the peripheral lip of the wound with a curette should enable most of the soft lens-matter to escape, without injury to the iris. In many cases a vertical incision in the outer part of the cornea is preferred (unless chloroform be administered), owing to the early age and consequent want of control of the patients. The point of the keratome is directed obliquely towards the iris, until, by its lustrous appearance, it is seen to have entered the anterior chamber; it is then passed on parallel with the



LINEAR EXTRACTION.

surface of the iris. The curette frequently has to be introduced into the anterior chamber for the removal of some of the lens-matter. If the cataract is at all unripe, its removal will be incomplete; iridectomy will be required, and the wound should therefore be above. It is as well then to have the incision just beyond the limbus, in order to get a conjunctival covering. This can be got by sliding the conjunctiva, caught on the point of the keratome; or a narrow knife may be used to cut outwards, and so to fashion a conjunctival flap. With the narrow knife the section may be, of course, slightly

larger than with the keratome, if thought necessary. Thus a near approach is made to extraction as practised for hard cataracts.

Where there is slight iritis or high tension, the operation will be painful if done under cocaine anæsthesia; chloroform is therefore demanded in children. The evacuation is greatly aided by irrigation with normal saline; much unripe lens-substance can often be got away thus. Irrigation of the anterior chamber may be offered as a rational substitute for the old *suction* operations, still occasionally performed. It is, however, better to leave much of the lens behind, and to trust in atropine afterwards, than to continue in prolonged efforts at removal. For the treatment of iritis caused by swollen cataract, a very partial evacuation suffices if undertaken early, and for the reduction of high tension the mere incision is almost enough. The tender age of the patient may sometimes not permit of the use of atropine after operation to the extent desirable.

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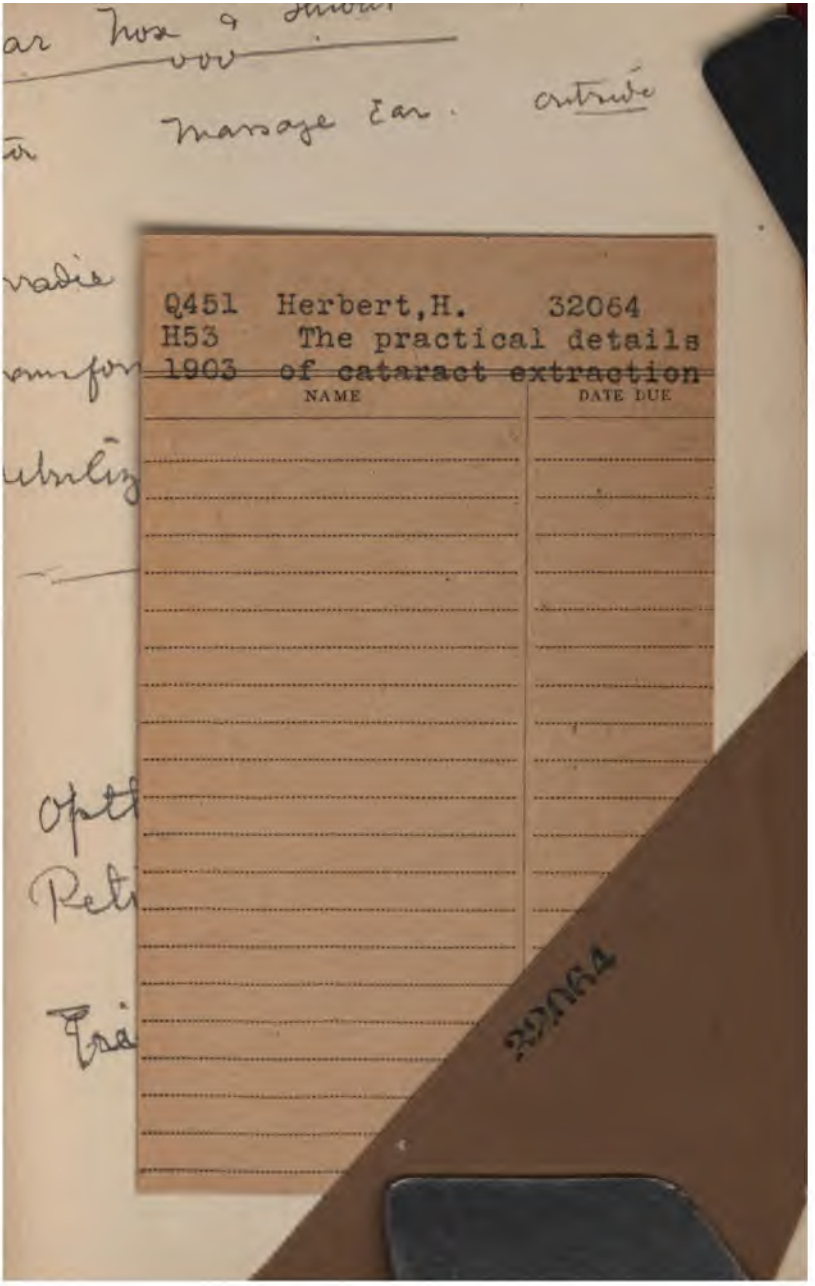
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